

**MISSOURI RIVER REGION - FY 1998
INTERIOR LEAST TERN
AND PIPING PLOVER**

**BIOLOGICAL OPINION
COMPLIANCE REPORT**
AND PERMIT ACTIVITY REPORT

DISTRIBUTION STATEMENT A
Approved for Public Release
Distribution Unlimited

March, 1999



**US Army Corps
of Engineers**

Omaha District

DTIC QUALITY INSPECTED 4

20001010 065

REPORT DOCUMENTATION PAGE

Form Approved
OMB No. 0704-0188

Public reporting burden for this collection of information is estimated to average 1 hour per response, including the time for reviewing instructions, searching existing data sources, gathering and maintaining the data needed, and completing and reviewing the collection of information. Send comments regarding this burden estimate or any other aspect of this collection of information, including suggestions for reducing this burden, to Washington Headquarters Services, Directorate for Information Operations and Reports, 1215 Jefferson Davis Highway, Suite 1204, Arlington, VA 22202-4302, and to the Office of Management and Budget, Paperwork Reduction Project (0704-0188), Washington, DC 20503.

1. AGENCY USE ONLY (Leave blank)		2. REPORT DATE March 1999		3. REPORT TYPE AND DATES COVERED Final	
4. TITLE AND SUBTITLE MISSOURI RIVER REGION - FY 1998 INTERIOR LEAST TERN AND PIPING PLOVER: BIOLOGICAL OPINION COMPLIANCE REPORT AND PERMIT ACTIVITY REPORT				5. FUNDING NUMBERS NA	
6. AUTHOR(S) U.S. ARMY CORPS OF ENGINEERS, OMAHA DISTRICT					
7. PERFORMING ORGANIZATION NAME(S) AND ADDRESS(ES) U.S. ARMY CORPS OF ENGINEERS OMAHA DISTRICT 215 N. 17TH ST. OMAHA, NE 68102-4978				8. PERFORMING ORGANIZATION REPORT NUMBER NA	
9. SPONSORING / MONITORING AGENCY NAME(S) AND ADDRESS(ES)				10. SPONSORING / MONITORING AGENCY REPORT NUMBER	
11. SUPPLEMENTARY NOTES					
12a. DISTRIBUTION / AVAILABILITY STATEMENT DISTRIBUTION STATEMENT A. APPROVED FOR PUBLIC RELEASE; DISTRIBUTION IS UNLIMITED.				12b. DISTRIBUTION CODE UL	
13. ABSTRACT (Maximum 200 words) This Compliance Report will replace annual reporting of tern and plover activities by the Omaha District Corps of Engineers which, to date, has been done in the Annual Operating Plans (AOP's) produced by the Region's Reservoir Control Center (RCC). In addition, the annual Permit Activity Report, previously a separate document prepared for the Service, is included as an appendix to this Compliance Report. Since this report will now be more than a Program Summary, and will represent the sole written documentation of compliance with the Opinion, the report title has been changed to "Biological Opinion Compliance Report," beginning this year.					
14. SUBJECT TERMS interior least tern; piping plover				15. NUMBER OF PAGES	
				16. PRICE CODE	
17. SECURITY CLASSIFICATION OF REPORT UNCLASSIFIED	18. SECURITY CLASSIFICATION OF THIS PAGE UNCLASSIFIED	19. SECURITY CLASSIFICATION OF ABSTRACT UNCLASSIFIED	20. LIMITATION OF ABSTRACT UNCLASSIFIED		

TABLE OF CONTENTS

I.	Purpose of the Compliance Report.	1
II.	Background Information	3
III.	Implementation of the Biological Opinion	5
1.	Reasonable and Prudent Alternatives	5
2.	Reasonable and Prudent Measures	10
3.	Conservation Recommendations	17
IV.	Summary and Conclusions	20
V.	References	22
VI.	Appendices	
A.	Biological Opinion	
B.	FY 98 Plans	
C.	Permit Activity Report	
D.	Habitat Work	
E.	Survey / Monitoring	
F.	Public Awareness	
G.	Other Studies	
H.	Budget Information	

SUMMARY OF FIGURES

Figure 1	Missouri River Study Areas	2
Figure 2	Missouri River Main Stem Annual Runoff 1890 - 1998 . .	4
Figure 3	1998 Missouri River Runoff	4
Figure 4	Fledge Ratios by Study Reach, 1998	10
Figure 5	Fledge Ratios in the Missouri River System, 1986 - 1998 .	11
Figure 6	Adult Bird Distribution, 1998	12
Figure 7	Adult Census vs. Annual Runoff, 1986 - 1998	13
Figure 8	1998 Public Awareness Activities by Office	17
Figure 9	1998 District Execution of Required Tasks.	20
Figure 10	1998 District Execution of Conservation Measures	21

I. PURPOSE OF THE COMPLIANCE REPORT

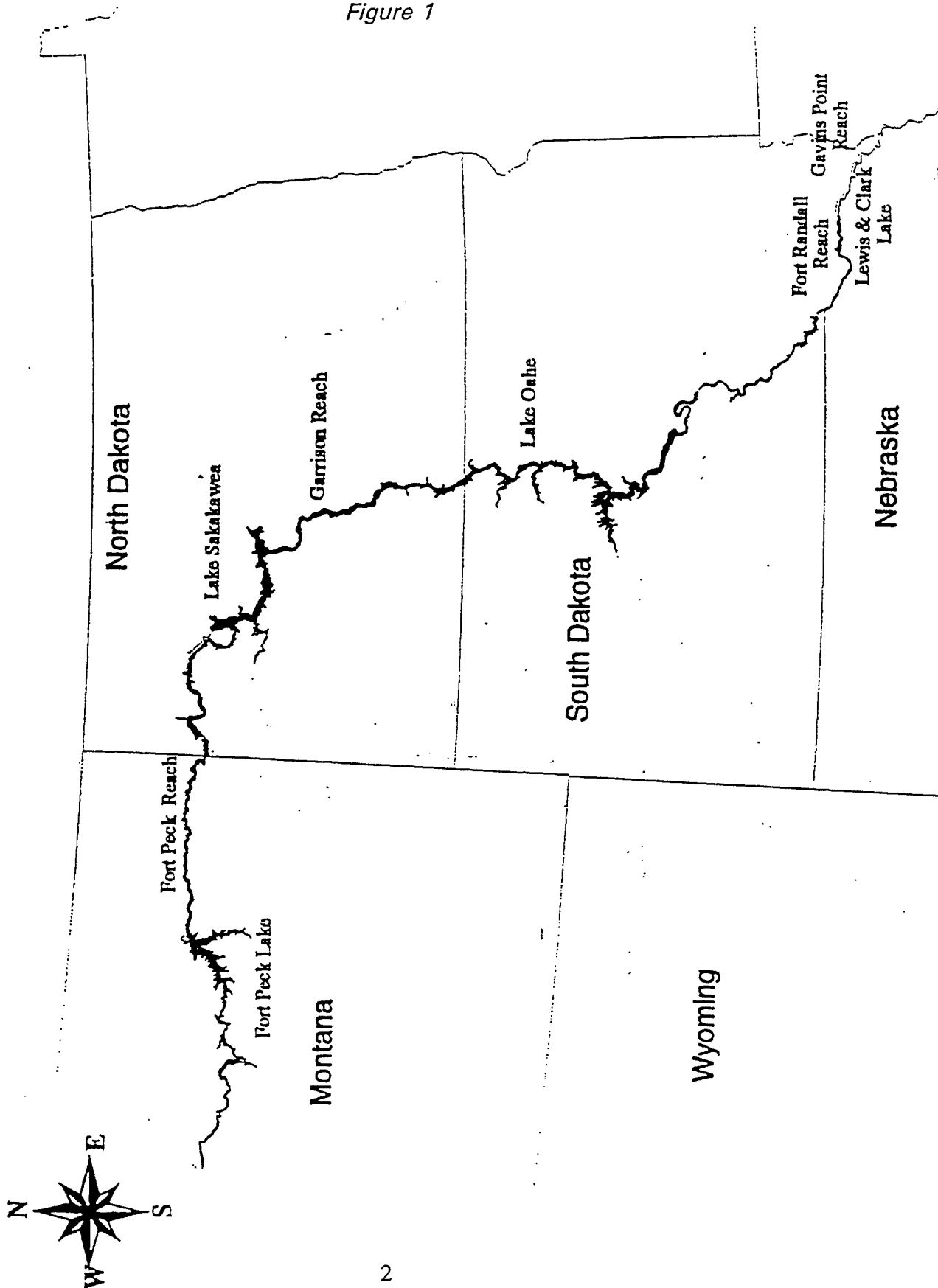
The Omaha District Corps of Engineers (District) has been involved in least tern and piping plover studies since the mid 1980's. Actions were increased following the issuance of a Biological Opinion (Opinion) by the U.S. Fish and Wildlife Service on November 14, 1990. Initial District implementation of that Biological Opinion began in 1992, following the development of a one-year work plan. Full District implementation of the Biological Opinion began in 1993, after the development of an implementation plan, "Omaha District's Fiscal Year 1993 - Fiscal Year 1995 Plan for Habitat Improvement for the Interior Least Tern and the Piping Plover," commonly known as the "Red Book." The Red Book was reviewed by the U.S. Fish and Wildlife Service and approved for implementation by the Missouri River Division of the Corps of Engineers (now the Missouri River Region, or "Region"). Corps' responsibilities under the Opinion lie within the Missouri River from Fort Peck Dam to Ponca, Nebraska, and the Missouri River Reservoirs (see Figure 1).

Survey and monitoring data has always been summarized annually, as required by the Opinion and the Service collection permit for such monitoring. Program Summaries, including public awareness activities, were prepared during fiscal years 91, 92, and 97 as documentation of all activities within the least tern and piping plover program that occurred during those fiscal years. Some duplication of effort was still evident, such as overlap among the Annual Operating Plans (AOP's), annual permit reports, and the Program Summaries.

Beginning with FY 98, compliance with the Opinion (for the District and the Region) and with the Service's collection permits will be accomplished utilizing one report. This Compliance Report will replace annual reporting of tern and plover activities which, to date, has been done in the Annual Operating Plans (AOP's) produced by the Region's Reservoir Control Center (RCC). In addition, the annual Permit Activity Report, previously a separate document prepared for the Service, is included as an appendix to this Compliance Report. Since this report will now be more than a Program Summary, and will represent the sole written documentation of compliance with the Opinion, the report title has been changed to "Biological Opinion Compliance Report," beginning this year.

The intent of the 1998 Compliance Report is to demonstrate to the Service, other interested agencies and Corps personnel that the Region has met all of its obligations, including flow-related tasks, under the 1990 Biological Opinion during this past year.

MISSOURI RIVER STUDY AREAS



II. BACKGROUND INFORMATION

Biological Opinion

In 1985, the interior population of the least tern was listed as an endangered species, and the Northern Great Plains population of the piping plover was listed as a threatened species. In 1986, the Service requested that the Corps enter into formal consultation on the operation of the Missouri River Main Stem system and the impact of ongoing operations on federally listed species. Also in 1986, the Corps began funding studies to learn more about the interior least tern and the piping plover within the Missouri River system. In 1987, the Region prepared a Biological Assessment (BA) on the effects of the Missouri River Main Stem system on the least tern and piping plover. The BA concluded that "reservoir releases can affect habitat for both the interior least tern and the piping plover" (U.S. Army Corps of Engineers, 1987).

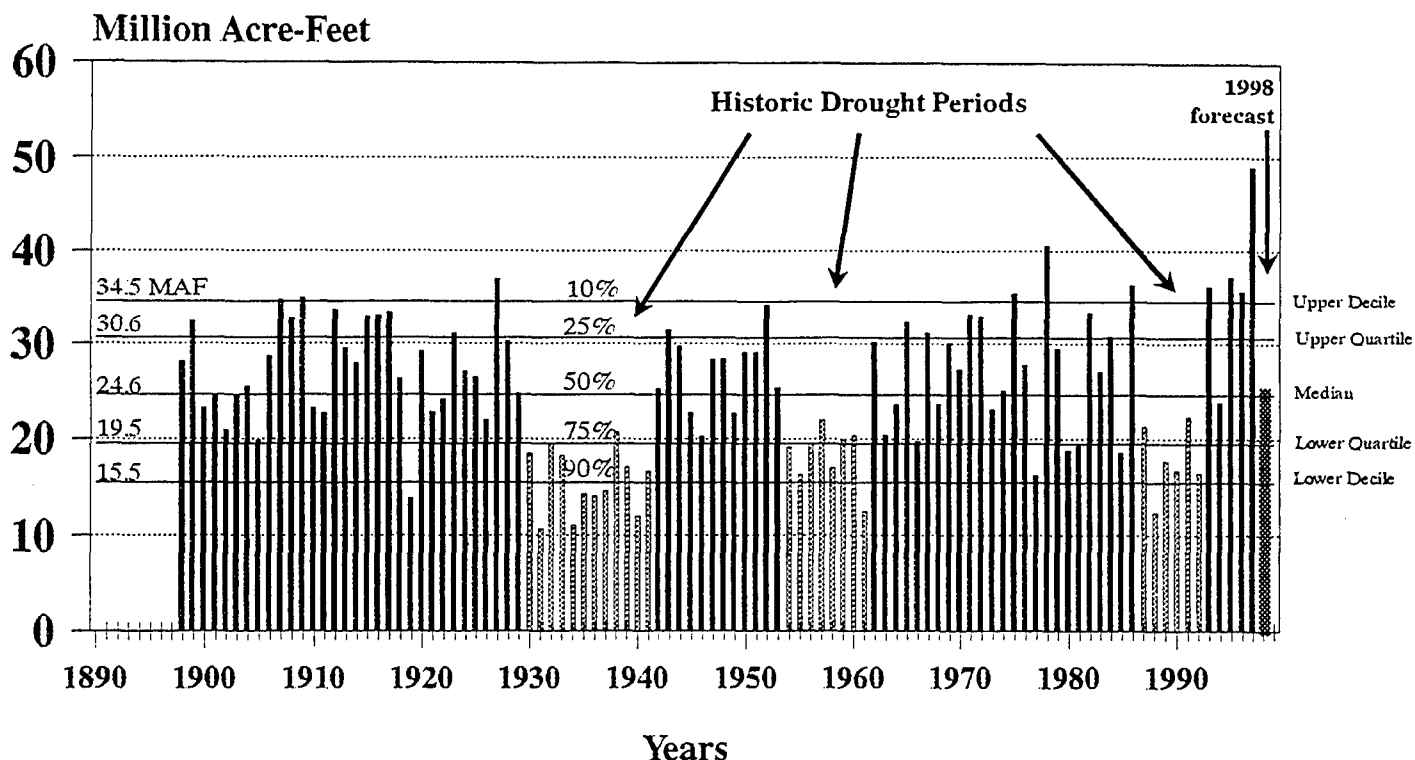
The BA was transmitted to the Service on October 19, 1987. On May 26, 1989, the Region requested the Service prepare a Biological Opinion on the operation of the Missouri River Main Stem System (System). The Service's Biological Opinion (Opinion) resulting from this request was sent to the Region on November 14, 1990. The Opinion concluded that "the operations of the System are likely to jeopardize the continued existence of the endangered interior least tern (*Sterna antillarum*) and the threatened piping plover (*Charadrius melodus*) because operations eliminate essential nesting habitat and could result in the loss of at least 12 percent of the interior least tern population and 22 percent of the Northern Great Plains piping plover population..." The Opinion described Reasonable and Prudent Alternatives that could be implemented by the Corps to avoid jeopardizing the two species, Conservation Actions to assist in the recovery of the birds, and Reasonable and Prudent Measures to minimize or avoid the "taking" of terns or plovers or their habitat. A summary of all tasks suggested by the Service in the Opinion can be found in Appendix A. A discussion of how these tasks were met during 1998 can be found in Section III, the Implementation of the Biological Opinion by the Missouri River Region.

Summary of 1998 Weather and Hydrological Conditions

1998 was a year of near normal runoff in the Missouri River basin. Total 1998 runoff was 26.9 million acre-feet (MAF), very near the normal of 24.6 MAF. Mountain snowpack was at normal to slightly below normal levels. El Nino-induced dryness also limited the accumulation of snowpack on the northern plains. Figure 2 summarizes annual runoff since 1890, and Figure 3 describes 1998 runoff.

Figure 2

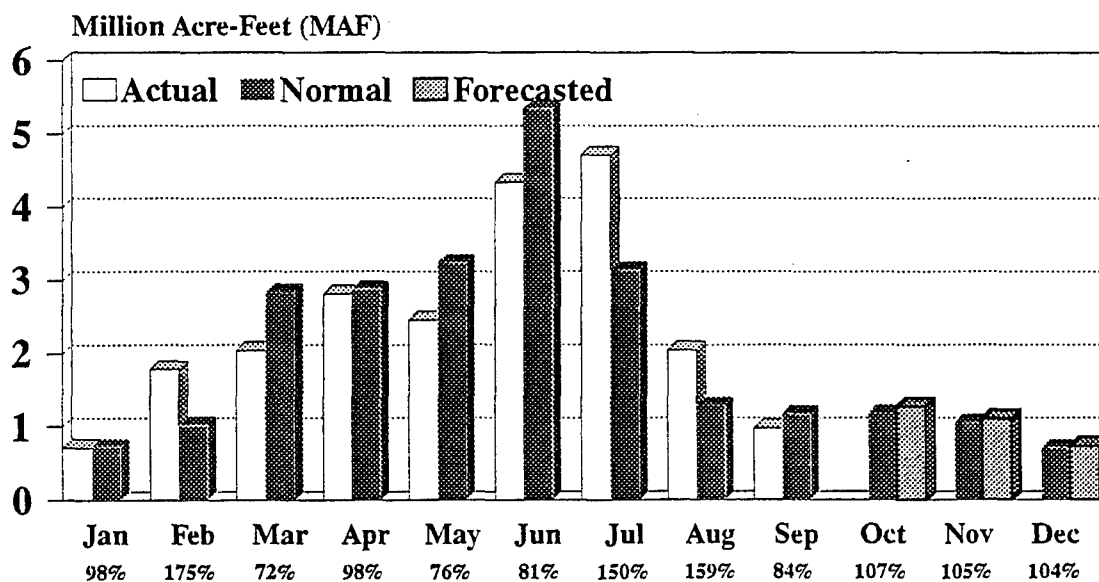
Missouri River Main Stem Annual Runoff above Sioux City, Iowa



Median Annual Runoff = 24.6 MAF
1998 Forecasted Runoff = 25.0 MAF

Figure 3

1998 Missouri River Runoff Above Sioux City, Iowa



1998 Forecasted Runoff: 25.0 MAF - 102%

III. IMPLEMENTATION OF THE BIOLOGICAL OPINION - 1998

Implementation of the Opinion is done annually by the District and the Region. The District was tasked by the Region to implement all tasks except Reasonable and Prudent Alternative 1a and 4, and Reasonable and Prudent Measure 4. The remaining tasks primarily relate to flows and therefore have been implemented by the Region. The reinitiation of consultation, should new information become available, is also the responsibility of the Region. Opinion tasks are included as "bold" text below. An asterisk (*) indicates tasks that the Region is responsible for; no asterisk indicates a District task.

Reasonable and Prudent Alternatives

Reasonable and prudent alternatives are defined as "alternative actions, identified during formal consultation, that can be implemented in a manner consistent with the intended purpose of the action, that can be implemented consistent with the scope of the Federal Agency's legal authority and jurisdiction, that are economically and technologically feasible, and that the Service believes would avoid the likelihood of jeopardizing the continued existence of listed species or result in the destruction or adverse modification of critical habitat."

***1a. Operational-caused flooding of nests or habitat should be avoided during the nesting season. Therefore, flows during the nesting season will be set by nest initiation. Once nests have been initiated, flows should not be increased to imperil nests.**

In order to reduce the flooding potential of nests and young birds, two water control strategies are employed. First, when birds commence nesting in May, daily dam releases are bumped up to a level that will provide adequate habitat and anticipated adequate service to project uses later in the summer. This level of release is intended to remain nearly constant the entire nesting season but may be adjusted downward for downstream flooding or upward for storage evacuation caused by high runoff events. In 1998 Gavins Point releases were increased to 32,000 cfs on May 18, less than half of the previous year's high release. Releases were cut back for flood control June 2-25 to as low as 22,000 cfs. Birds continued nesting high, and releases were returned to 30,000 cfs near the end of June. Releases fluctuated in July between 25,000 and 31,000 cfs for flood control. At Fort Randall releases were cut back from the established 27,000 cfs level to 16,000 cfs by June 15 for flood control. Two nests were moved higher when releases were returned to 25,000 cfs near month's end. Garrison releases were increased to 26,000 cfs on May 16 as plovers began nesting. They were reduced to 25,000 cfs near the end of June and to 24,000 cfs in early July for intrasystem reservoir storage balance. This added to the already excellent habitat in this reach. In mid-May Fort Peck daily average releases were increased from

9,000 cfs to 10,000 cfs as plovers were in the area. Fort Peck releases were reduced to near 7,500 cfs July 8-12 as the Milk River was adding increased tributary flow to the river then returned to the 10,000 cfs rate.

Second, an hourly hydropower peaking release pattern is established in May for Fort Peck, Garrison, and Fort Randall that will later ensure river stages conducive to safe nesting through the summer, but also satisfy power needs later in the summer. For the 1998 season there were no peaking releases at Gavins Point, Fort Randall peaking was limited to no more than 87 percent of maximum for no more than 6 hours, Garrison was limited to no more than 82 percent for 6 hours, and Fort Peck to 91 percent for no more than 6 hours. The Fort Peck hourly peaking limit was exceeded July 4-7 to cover increased power demand after nest elevations were determined high enough to be free from flooding.

The Corps did not attempt to limit reservoir elevation increases, as this would interfere with flow restrictions for the birds nesting on downstream river reaches.

1b. Natural nesting habitat should be provided as a priority and other management actions implemented to meet or exceed fledge ratio goals (i.e. 0.70 for terns and 1.44 for plovers). The Corps should, based in part on past years' information, determine the habitat necessary for each river reach and provide management actions within the Corps' authorities to meet or exceed fledge ratios. The Corps should use the following parameters when determining habitat and management actions needed to meet or exceed fledge ratios:

- proximity to foraging habitat no greater than 400 meters from an area that provides schooling and feeding fish that are 3 inches in size
- substrate consisting of very fine to fine sand for terns, and some gravel for plovers
- vegetation should be no greater than 25 percent cover, with optimum cover at 10 percent or less
- nesting areas should be 8 inches or greater in elevation above river levels
- nesting should be substantially disturbance-free from both predation and human disturbance

During September, 1998, the south side of a peninsula at Little Bend (RM 1109) on Lake Oahe was removed as part of a training exercise for the South Dakota National Guard (Pierre). This action, which involved digging holes and igniting sticks of C. (dynamite) and fertilizer in the holes, resulted in vegetation removal on the peninsula in preparation for spring nesting.

On the Fort Peck river reach, cottonwood and willow trees (RM 1580.5) were removed by spraying, then using a brush hog and mower. An additional 40 acres of young cottonwoods and willows were sprayed with Rodeo herbicide at RM 1562.5 - 1580.5.

In the Lake Sakakawea area, a habitat creation project was conducted on Lake Audubon, in cooperation with the Bureau of Reclamation and the U.S. Fish and Wildlife Service. The impoundment behind Dike 1A was dewatered so a one-acre island could be built using earthmoving equipment.

High 1995, 1996, and 1997 flows resulted in an abundance of high-elevation sandbar habitat below Gavins Point Dam and Garrison Dam, and, to a lesser extent, below Fort Randall Dam and Fort Peck Dam.

1c. When flows below main stem dams may inundate much nesting habitat, other means will be necessary to establish nesting habitat to meet fledge ratio goals. Created habitat should be established to accommodate the following release flows by river reach and to supplement natural habitat required by Alternative 1b above.

Fort Peck - - above 8,500 cfs and below 13,200 cfs
Garrison - - above 18,000 cfs and below 31,000 cfs
Fort Randall - - above 28,000 cfs and below 38,500 cfs
Gavins Point - - above 30,000 cfs and below 39,500 cfs

Flows at applicable dams within the Missouri River system ranged as indicated below from May through August, 1998:

Fort Peck - - - -	7,900 - 12,700 cfs	within the flow window
Garrison - - - -	19,300 - 26,400 cfs	within the flow window
Fort Randall - -	14,800 - 29,600 cfs	just above the low end of the flow window
Gavins Point - -	22,000 - 32,000 cfs	just above the low end of the flow window

When flows are below the "flow windows" established in the Opinion, there should already be enough sand exposed for tern and plover habitat that year, but low water years may be ideal for creation of habitat to accommodate subsequent flows within the flow windows. When flows exceed the "flow windows," it indicates an unusually wet year during which nesting everywhere (even uncontrolled rivers) is likely to be inundated. Even artificially-created "high elevation" habitat is at risk when the upper limits of the "flow windows" are exceeded.

High flows from Fort Peck, Garrison, Fort Randall, and Gavins Point Dams during 1997 aided in scouring existing vegetation at elevations within the flow windows, as well as forming high-elevation sandbar habitat that was utilized during 1998. There was an abundance of high elevation habitat available for tern and plover use, and additional habitat creation below these dams was not necessary. Additionally, flows at Fort Randall, Gavins Point, and Fort Peck dam were only about one-half of those in 1997 for much of the time from May - August, exposing more additional sand for habitat.

Appendix D contains photos of flow-created and maintained habitat now present.

2. The Corps should provide information on tern and plover management strategies during the development of the draft Annual Operating Plan in the fall and after March 1 when the runoff forecast is made.

Information on projected 1998 tern and plover management strategies was sent to the Region for inclusion in the 1997-98 AOP. Information on 1998 management strategies was also sent to the U.S. Fish and Wildlife Service as part of the 1998 permit application request. This document contains information on implemented tern and plover strategies, including the 1998 permit report, found in Appendix C.

3. The Corps should compile a separate annual report by December 31 of each year or include in the Annual Operating Plan a report outlining tern and plover management actions, including reasonable and prudent alternatives and reasonable and prudent measures implemented during the operating year, their success in attaining fledge ratio standards and meeting habitat needs, and anticipated actions for the upcoming year. Monitoring information in the report should include:

- tern and plover fledge ratios
- tern and plover population survey results
- nest elevations
- mapping of nesting habitat
- estimates of sandbar acreage at least every three years
- historic hourly release data from May 1 to August 30

This document serves as the 1998 documentation of tern and plover management strategies in the Missouri River basin.

***4. The Corps should form a Missouri River Tern and Plover Management Team (Team). The Team will consist of federal and state wildlife agencies. The annual report will be provided to this Team by December 31 of each year. The Team will review the annual report and provide management views to the Corps for the following operating season. The Team will meet shortly after March 1 of each year to provide views to the Corps. The Corps will be responsible for scheduling and arranging the Team meetings.**

The Missouri River Natural Resources Committee (MRNRC) established a tern and plover technical subcommittee at their March 1992 meeting. The first subcommittee meeting was held in July 1992. The Corps of Engineers actively participates on the subcommittee, which met in October, 1998.

5. The Corps should map on a periodic basis (at least every three years) all essential tern and plover nesting habitat used by terns and plovers on the Missouri River.

Each field office manually maps nesting habitat each year for inclusion in the annual report. This information is entered into the GIS database by year in order to determine long-term trend information. Maps of nesting habitat can be found at the end of the Permit Activity Report found in Appendix C.

Recently, however, mapping efforts have been focused on establishing geographically referenced base maps to use as the foundation for a habitat conservation plan. National Wetland Inventory maps will be used for the base maps in reservoir areas, while digital orthometric imagery will be used as the base map for river reaches.

Digital orthometric aerial photography was done below Gavins Point and Garrison dams in May, 1998, and below Fort Peck Dam and Fort Randall Dam in August, 1998. The information from below Gavins Point Dam has been categorized into habitat types and areas calculated for each habitat type. The information from below Garrison Dam will be the next to be categorized, and is anticipated to be done by March, 1999.

6. The Corps should continue its "Investigation of Channel Degradation" studies to research the long-term effects of riverbed changes and its impact to tern and plover nesting habitat, forage availability, and forage areas. The results of these studies should be reported each year in the annual report and considered and included as appropriate.

Channel degradation studies are done approximately every ten years, as funding allows, below the Missouri River mainstem dams. The purpose of this program, also known as the Sedimentation Program, is to systematically assess the operating conditions of the Omaha District reservoirs as they relate to sedimentation issues. The program includes periodic surveying, bed material sampling, analysis to establish trends, and prediction of future conditions (U.S. Army Corps of Engineers, 1998). The type of information gathered at the permanently-established cross-sections over time can provide insight into the water depths available at a certain discharge; variation in island height, shape, and location; and some information on bank erosion as related to the permanent monuments. This information is supplemented by other Corps efforts, such as the erosion studies done below each dam, as well as aerial mapping of the river.

The most recent channel degradation studies done below Garrison Dam were in 1989, with anticipated follow-up studies in 1999, if funding allows. Channel degradation studies below Gavins Point Dam, Fort Peck Dam, and Fort Randall Dam were done in 1995, 1992, and 1994, respectively.

During 1998, digital ortho aerial photography, another method of monitoring island locations and areas, was done below Gavins Point Dam, Garrison Dam, Fort Peck Dam, and Fort Randall Dam. Information from these images is downloaded and classified into habitat types. The information from below Gavins Point Dam has been classified, and acreages by habitat type can be determined. The information from below Garrison Dam will be done next, with completion expected in March.

Reasonable and Prudent Measures

The Service considers Reasonable and Prudent Measures as conditions or actions necessary and appropriate to minimize "take." Section 9 of the Endangered Species Act (Act) makes it unlawful for any person to "take" an endangered species. As defined by the Act, the term "take" means "to harass, harm, pursue, hunt, shoot, wound, kill, trap, capture, or collect or attempt to engage in any such conduct" [16 USC 1532(19)]. Further, "harm" is defined to include "an act...[that] may include significant habitat modification or degradation where it actually kills or injures wildlife by significantly impairing essential behavioral patterns including breeding, feeding, or sheltering" (50 CFR 17.3). However, Section 7(b)(4) of the Act permits taking of some individuals of an endangered species, if the taking is incidental to the Federal action under consultation, and such incidental taking is not to the degree that the continued existence of the species is likely to be jeopardized [50 CFR 402.14(i)].

1. All tern and plover nesting habitat on riverine reaches below dams, including the headwaters of Lewis and Clark Lake, as well as reservoir areas during long-term drought, should be monitored (fledge ratios determined) and surveyed (total adult bird count) on a yearly basis during the May through August nesting seasons so that operations of dams may continue in a manner to avoid the unnecessary taking of birds. Long-term drought periods are defined as 2 or more years of equal to or less than 45 million acre-feet of year-end storage with less than median inflows.

Tern and plover survey and monitoring efforts for 1998 are summarized in Appendix C. Relevant tables and charts are included below.

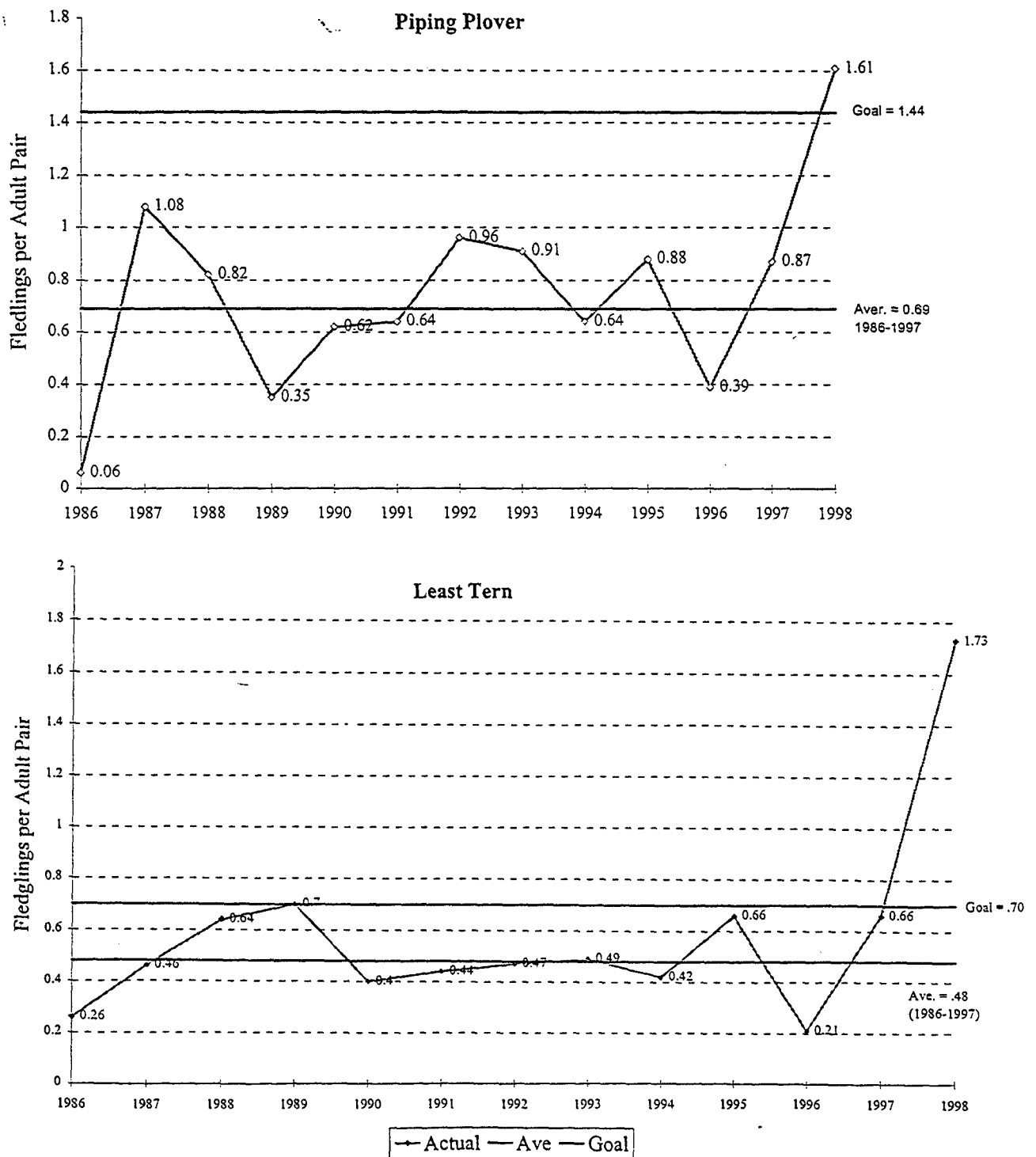
Figure 4
Fledge Ratios by Study Reach, 1998

<u>Location</u>	<u>Tern Goal</u>	<u>Tern Actual</u>	<u>Plover Goal</u>	<u>Plover Actual</u>
Fort Peck Lake	0.70	0.00	1.44	0.00
River below Peck	0.70	1.52	1.44	1.00
Lake Sakakawea	0.70	1.04	1.44	1.24
River below Garrison	0.70	1.52	1.44	1.84
Lake Oahe	0.70	1.29	1.44	1.06
River below Ft. Randall	0.70	0.94	1.44	1.27
Lewis and Clark Lake	0.70	2.33	1.44	2.45
River below Gavins Point	0.70	2.33	1.44	2.20
System Total	0.70	1.73	1.44	1.61

Source: U.S. Army Corps of Engineers, 1998

System total fledge ratios on the Missouri River system were exceeded for the first time since the Corps began tracking these ratios. High flows in previous years have developed vast areas of vegetation-free high elevation sandbar habitat in the riverine portions of the Missouri River basin.

Figure 5
Fledge Ratios on the Missouri River System, 1986 - 1998

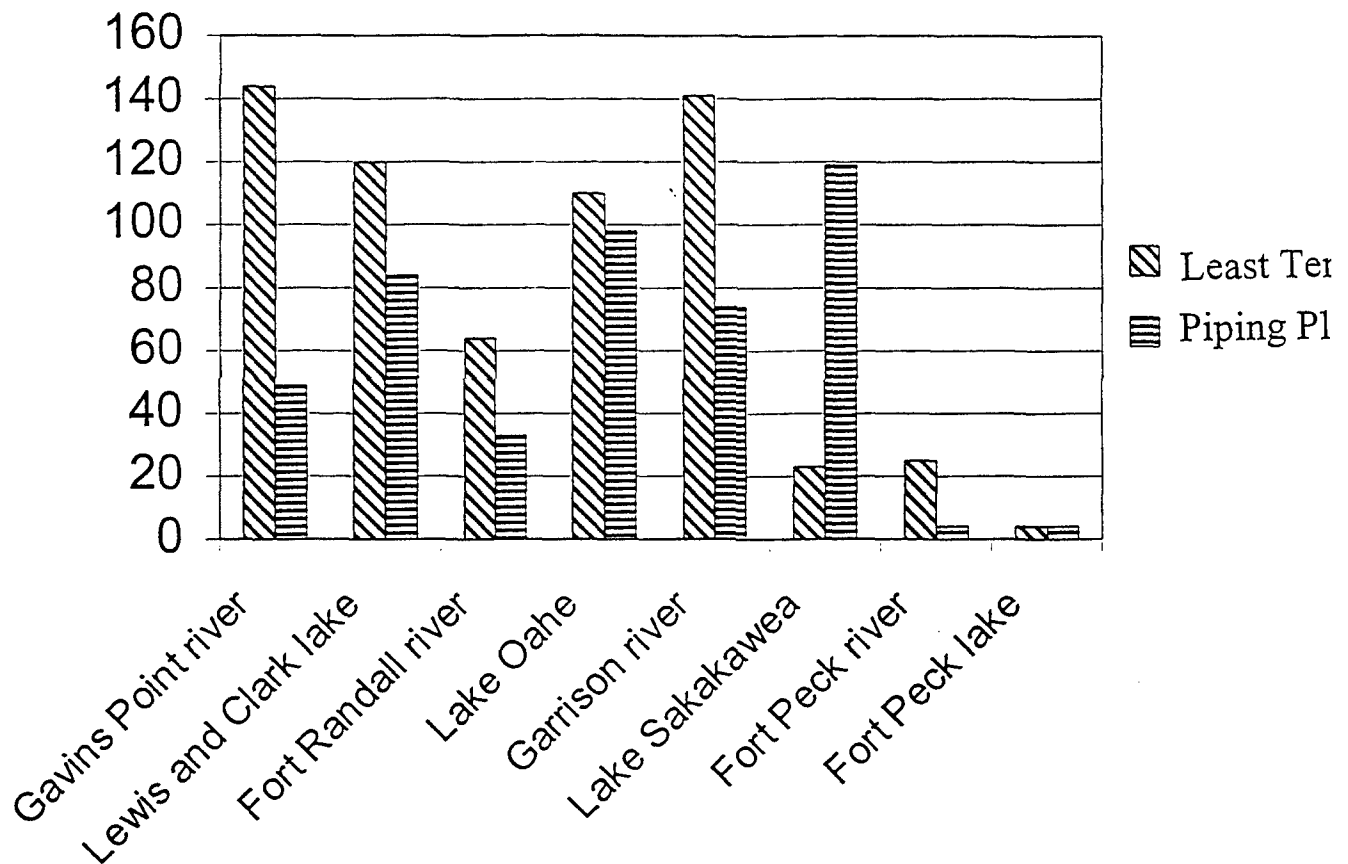


The adult census was conducted during the following timeframes, by study area:

Fort Peck River	June 22, 29, 30
Garrison River	June 22-24, July 1,3
Fort Randall River	June 24
Gavins Point River	June 22, 24-26

Figure 6 summarizes adult bird distribution in the Missouri River system during 1998. Study reaches that are not on Figure 5 did not have adult birds reported as a result of monitoring. Reservoir areas are included in Figure 6, even though monitoring the reservoirs is considered a Conservation Measure during non-drought years.

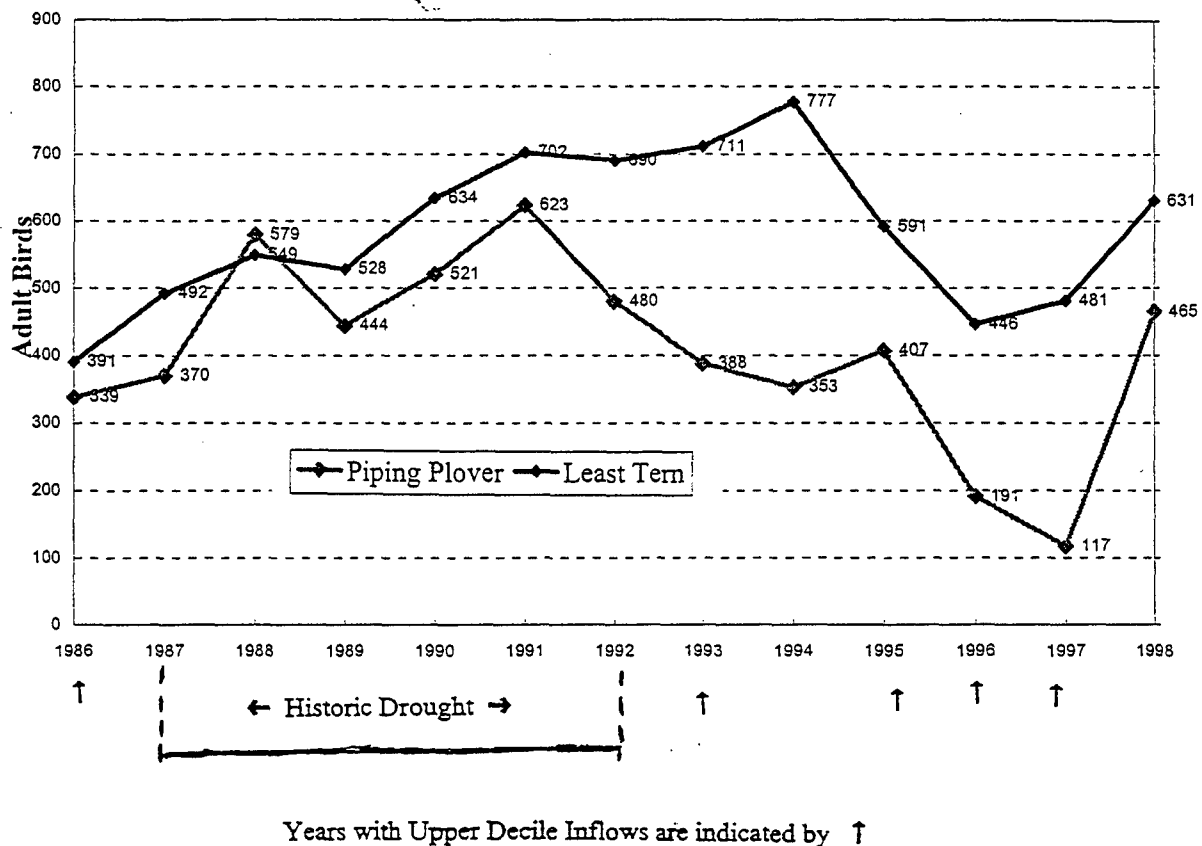
Figure 6
Adult Bird Distribution, 1998



Source: U.S. Army Corps of Engineers, 1998

Figure 7 compares total adult census information by year with annual runoff records (from Figure 2).

Figure 7
Annual Adult Census vs. Annual Runoff, 1986 - 1998



Source: U.S. Army Corps of Engineers, 1998

Monitoring on Corps' reservoirs was not required during 1998, since the Missouri River basin was not in a drought situation ("drought" meaning system storage less than or equal to 45 million acre-feet and less than median inflows). Year-end storage for 1998 was 58 million acre-feet, with median inflows (Keasling, personal communication).

Training for monitoring and surveying activities occurs annually. During 1998, training for summer rangers from five Corps' projects was held at Riverdale, North Dakota on June 1-2. Training is conducted by Casey Kruse and Greg Pavelka. Each project also has taped training segments on hand for refresher training.

2. The Corps should continue monitoring daily and hourly fluctuations in releases below all dams or any changes in release due to maintenance or other reasons and use this information in combination with measure 1 above to avoid and minimize take and document unavoidable taking.

Stream gages have been installed on the Missouri River to monitor stream flows during the nesting season and to provide a stage history throughout the season. Information from the gages helps the Corps relate the effects of regulation and natural events at intervals along the river. A dynamic flow routing model has been developed to closely predict maximum river stages along the river for different combinations of daily discharge and hourly power peaking characteristics.

Special flow controls for the terns and plovers are accomplished by the Region annually. These special flows consist of setting a constant daily flow level from the dams when the birds begin nesting and limiting hourly peaking power releases to ensure safe nesting (refer to pg. 5 of this report for details of these flows for the 1998 nesting season). Eight nests were taken in reservoir areas during 1998 as a result of rising lake levels. The Corps does not attempt to regulate lake levels for birds because this would involve fluctuating releases with the potential of destroying the birds on the river stretches. One nest was taken below Fort Randall after resuming releases that had been cut back for flood control.

Hourly values of reservoir releases and elevations, as well as river stages, are available at the Corps Reservoir Control Center in Omaha in either text or graphical form. Data for 1998 show river stages conducive to the record bird reproduction due, in part, to the special flow conditions adopted by the Corps.

***3. If the Corps develops new operational scenarios that were not considered during this consultation, then consultation for these new actions will need to be reinitiated.**

The Corps developed a new Biological Assessment (BA) (December 1998) on the affect of the operation of the Missouri River Main Stem System of reservoirs (System) on threatened and endangered species. The BA analyses assumed continued System operation given the guidelines documented in the current Master Water Control Manual. The BA documented our finding that the current operation of the System may adversely affect the interior least tern, piping plover, and pallid sturgeon. Therefore, we have requested the USF&W to re-initiate formal Section 7 ESA consultation on the current operation of the System for all listed species. We will consider any flow recommendations presented by the USF&W during consultation. Those flow recommendations that would have a significant impact to

the human environment will be included in the ongoing Master Manual NEPA process, which is scheduled for completion in the fall of 1999.

4. The Corps should implement public information and education programs to increase public awareness and reduce disturbance to nesting birds

Public awareness is often done by the field offices in the form of campfire talks. A summary of 1998 public awareness activities are listed below. Informational full-color endangered species posters, including information on terns and plovers, are posted annually at select river access locations. Permanent signs are also placed at the most heavily-used river access locations within the tern and plover nesting range. Tern and plover information is always accessible on the Water Resources Branch homepage on the internet (<http://www.nwo.usace.army.mil/html/pd-e/ternplo3.htm>).

Coloring books and pamphlets were available at the visitor centers and powerhouses at Fort Randall and Gavins Point from May through September.

During January, 1998, the District received e-mail inquiries about terns and plovers in response to the Tern and Plover Slide show, accessible from the Corps' Water Resources Branch homepage.

The February 1998 Tern and Plover Symposium, held in Omaha, Nebraska, was co-sponsored by the Omaha District Corps of Engineers. Organizations represented at the symposium included Canadian, federal, and state natural resource agencies, universities, public utilities, zoos, and private conservation organizations. Several Corps' personnel gave talks, and Corps-funded studies were discussed. Casey Kruse gave two talks on the Corps' captive rearing program. Greg Pavelka gave a talk on the Corps' productivity surveys. Keith Gordon gave a talk on nest moving techniques. Stacy Adolf gave two talks on her study of least terns and piping plovers on the Niobrara River. Robyn Niver gave a talk on her juvenile piping plover survival study. A copy of the agenda is included in Appendix F.

During March, 1998, Casey Kruse gave presentations on endangered species to two biology classes at Yankton High School. Stacy Adolph also gave a talk on her study of least terns and piping plovers on the Niobrara River at the South Dakota Chapter of the Wildlife Society meeting in Pierre, South Dakota.

In April, Casey Kruse gave a presentation on endangered species to the Golden K's club at Yankton, South Dakota. Gary Gidley gave a presentation on endangered species as part of a water safety program given to Williston, North Dakota fourth grade students. Four hundred fourth graders participated in the program.

In May, Oahe Project ranger Julie Price did a radio spot, one newspaper article, and one junior ranger program on endangered species in Mobridge, South Dakota. Annual press releases, both radio transcripts and Super VHS "ready for TV," are sent out each year prior to the Memorial Day weekend in order to inform the public about the potential for human disturbance through sandbar use. Examples of the radio transcript, and a list of radio and television stations are included in Appendix F.

During June, Julie Price gave two talks to sportsman's groups, and did one radio spot and one newspaper article on endangered species at Mobridge, South Dakota.

In July, Gavins Point Project ranger Amy Johnson conducted a junior ranger program on endangered species at the Cottonwood Campground. Fort Peck personnel gave two campfire talks on endangered species at the Downstream Campground. Oahe Project ranger Julie Price conducted one junior ranger program on endangered species at Mobridge, South Dakota.

During August, Julie Price gave a talk on endangered species to one sportsman's group at Mobridge. Gavins Point Project personnel assisted in a Project WILD workshop for 24 area schoolteachers. The workshop focus was the ecology of the Missouri River, with Corps' personnel giving presentations on the Threatened and Endangered Species Program. Casey Kruse also spoke on endangered species at the Project WILD dinner at Aten's Resort, Nebraska. Lake Oahe - Pierre personnel gave a campfire talk on endangered species at the Downstream Campground.

In September, Robyn Niver produced a poster on her juvenile piping plover survival study for the Wildlife Society Conference, held in Buffalo, New York. Gail Campos from Omaha began updating the Water Resources Branch web page to include a slide show on tern and plover chick-rearing.

Casey Kruse gave presentations on endangered species to three biology classes in November, at Yankton High School. Becky Latka provided coloring books for distribution at Ponca State Park, Nebraska.

Casey Kruse gave other presentations on endangered species in December, to the 7th grade class at Ethan, and the 6th grade class at Parkston, both in South Dakota. Gail Campos from Omaha continued preparing a chick-rearing slide show for the Water Resources Branch web page, which should be approved and available for the public in February.

Public awareness activities are summarized by office in Figure 8.

Figure 8
1998 Public Awareness Activities by Office

Office	Technical Talks	Posters/ Color book	Campfire/ Schools	PSA's/ Media	Video	Other
Peck			X			
Garrison	X		X	X		
Oahe			X	X		X
Randall		X				
Gavins	X	X	X			X
Omaha		X		X	X	X

Conservation Recommendations

Section 7(a)(1) of the Act directs Federal agencies to further the purposes of the Act by carrying out conservation programs for the benefit of endangered and threatened species. Although such conservation recommendations are not required, they are recommended to help the recovery of the species. Conservation recommendations were not assigned to the Omaha District by the Region, but are implemented as time and funding allow.

1. Reservoir populations of least terns and piping plovers should be monitored and surveyed each year rather than just during drought periods (see Reasonable and Prudent Alternative 1). This information will help evaluate the System as a whole. Subsampling techniques to obtain statistically valid monitoring surveys are acceptable.

Adult bird census was conducted on the Missouri River reservoirs as indicated below:

Fort Peck Lake	June 23 & 25
Lake Sakakawea	June 22-26, 29-30, July 1
Lake Oahe	June 22-25, 30, July 1,2,& 4
Lewis and Clark Lake	June 29-30, July 2

Survey and monitoring results can be found in Appendix E.

2. Any maintenance dredging operations or dredging permits on the Missouri River should be evaluated by the Corps, in consultation with the Service, for creating tern and plover habitat. Where habitat creation is possible, the Corps will implement actions necessary to create habitat from dredged material.

No permits for dredging on the Missouri River were issued during 1998, according to Omaha District's Regulatory RAMS database.

3. The Corps should strive to meet Missouri River recovery goals for terns and plovers (800 tern adults for 10 years and 970 adults for 15 years) by implementing additional tern and plover management actions, beyond the scope of the reasonable and prudent alternatives, that would further increase productivity.

Management Actions taken in addition to normal surveying and monitoring actions are summarized in the 1998 Permit Report, found in Appendix C. Management Actions, including special studies, are briefly described here. For more details on these measures, see Appendix C, Permit Report, Management Actions.

Predator Aversion Measures. Predator exclusion cages are one means of protecting nesting plovers from predators. On the Missouri River system in 1998, 14% of the piping plover nests were protected by cages. Additionally, an electric barrier fence was constructed across a peninsula in the Steinke Bay area, Lake Sakakawea, to protect piping plover nests.

Restrictive Sign Posting and Fencing. The following areas received restrictive sign posting and/or fencing during 1998: Fort Peck Lake (Beach 1); Lake Sakakawea (Little Egypt, Tobacco Garden Bay, Steinke Bay, Fort Stevenson State Park), Garrison River (RM 1310), Lake Oahe (RM 1299, RM 1270, Mission Point 1104, Mission Island 1103.5), Fort Randall River (RM 851.7, RM 851.6), and Gavins Point River (RMs 804.4, 798.9, 789.0, 781.8, 766.2, and 756.5).

Law Enforcement Patrols. Corps personnel teamed with South Dakota Game and Fish personnel to monitor nesting sites at RMs 851.7, 842, and 838 over the July 4 weekend.

Nest Relocations. Nests were relocated to avoid rising lake or river levels at the following locations: Lake Sakakawea River reach (Lake Jessie), and the Fort Randall River reach (sandbar complex at Verdel).

Livestock Management. Livestock grazing at management units adjacent to Fort Peck Lake was delayed until July 15 where nesting was documented.

Contaminant Analysis. Deceased chicks and/or eggs from the Lake Oahe Reach and the Gavins Point Reach were sent to the U.S. Fish and Wildlife Lab in Madison, Wisconsin for contaminant analysis.

Niobrara River Study. This study on the distribution, productivity, and habitat use by terns and plovers on the Niobrara River was published in 1998.

Pre-Migratory Juvenile Survival Study. Survival of captive-reared chicks and wild-reared chicks is being studied by the University of Wisconsin, funded by the Corps. There were 23 piping plover chicks raised this year in the captive rearing facility as part of this study. 1998 was the first year of this 3-year study.

Banded Bird Sightings. Previously captive-reared chicks were sighted in Texas, Montana, Lake Oahe, Lewis and Clark Lake, and Florida.

IV. SUMMARY AND CONCLUSIONS

The Region has implemented all assigned tasks from the Opinion during 1998. Figure 9 summarizes the requirements of the Opinion and 1998 Corps actions that demonstrate that these requirements were met.

Figure 9
1998 Execution of Required Tasks

Opinion Tasks	Met?	Corps' Actions
Alt. 1a - don't flood nests	yes	water control strategies
Alt. 1b - habitat creation	yes	Lake Oahe, Fort Peck River Reach, Lake Audubon (see permit report)
Alt. 1c - high flow habitat	yes	below dams from high 1997 flows
Alt. 2 - mgt goals in AOP	yes	in 1997-98 AOP
Alt. 3 - annual report	yes	this is the Annual Report
Alt. 4 - tern and plover team	yes	MRNRC subcommittee
Alt. 5 - map nesting habitat	yes	digital orthos and GPS
Alt. 6 - channel degradation study	yes	continuing existing studies
Meas. 1 - survey and monitor	yes	river reaches monitored and surveyed
Meas. 2 - monitor flow fluctuations	yes	gage information factors into flow decisions from RCC
Meas. 3 - reinitiate consultation	yes	<i>MRR will write</i>
Meas. 4 - public awareness	yes	press releases, public and agency talks, videotape distribution, posters and coloring books, co-sponsor Tern and Plover Symposium

In addition to the above tasks, the Region also implemented Conservation Recommendations during 1998, as indicated in Figure 10. Conservation Recommendations are not requirements, but Federal agencies should, in good faith, do what can be done to speed the recovery of listed species.

Figure 10
1998 Execution of Conservation Recommendations

Conservation Tasks	Met?	Corps' Actions
1 - survey and monitor reservoirs	yes	all reservoirs monitored and surveyed
2 - review dredge permits	N/A	no Missouri River dredge permits in 1998
3 - actions to increase productivity	yes	predator cages, signs, extra studies, law enforcement, etc.

V. REFERENCES

Keasling, Robert. 1998. Personal Communication, Reservoir Control Center, Missouri River Region.

U.S. Army Corps of Engineers. 1987. Biological Assessment: Effects of Missouri River Main Stem System Operations on the Interior Least Tern and Piping Plover. Missouri River Division, October, 1987.

U.S. Army Corps of Engineers. 1993. Omaha District's Fiscal Year 1993 - Fiscal Year 1995 Plan for Habitat Improvement for the Interior Least Tern and Piping Plover. Omaha District document, May, 1993.

U.S. Army Corps of Engineers. 1998. Missouri River Main Stem Reservoirs 1997-1998 Annual Operating Plan and Summary of Actual 1996-1997 Operations. Missouri River Region, Reservoir Control Center, Omaha Nebraska. January, 1998.

U.S. Army Corps of Engineers. 1998. Draft Missouri River Main Stem Reservoirs 1998-1999 Annual Operating Plan and Summary of Actual 1997-1998 Operations. Missouri River Region, Reservoir Control Center, Omaha Nebraska. October, 1998.

U.S. Army Corps of Engineers. 1998. Missouri River Interior Least Tern and Piping Plover Permit Activity Report, Omaha District. December, 1998.

U.S. Fish and Wildlife Service. 1990. Letter and Biological Opinion on the Operations of the Missouri River Main Stem System to Brigadier General Eugene S. Witherspoon, Missouri River Division, from Galen Buterbough, U.S. Fish and Wildlife Service, dated November 14, 1990.

APPENDIX A

BIOLOGICAL OPINION

Brigadier General Eugene S. Witherspoon

Reasonable and Prudent Alternatives

Reasonable and prudent alternatives are defined as "alternative actions, identified during formal consultation, that can be implemented in a manner consistent with the intended purpose of the action, that can be implemented consistent with the scope of the Federal Agency's legal authority and jurisdiction, that are economically and technologically feasible, and that the Service believes would avoid the likelihood of jeopardizing the continued existence of listed species or result in the destruction or adverse modification of critical habitat."

As mentioned previously, the Missouri River is a dynamic system. Extremes can vary from years of very high inflow and high storage to years of low inflow and low storage. In the years since the least tern and piping plover have been listed (1986 to 1989), water flows have fluctuated greatly, from a high-water year in 1986 to extreme drought in 1989. The dynamics of the Missouri River system are such that management plans (Operating Plans) must be evaluated every year to adjust to system conditions.

The dynamics of the Missouri River and associated sandbar habitat appear to influence tern and plover population sizes. Analysis of piping plover and least tern population fluctuations in North Dakota indicate that these birds are limited by the amount of total available sandbar acreage. Fewer least terns and piping plovers nested on the Missouri River below Garrison Dam during years of high maximum June discharge and subsequently reduced sandbar acreage. Conversely, more terns and plovers nested on the Missouri River in years when June discharge rates were lower and hence allowed for greater sandbar acreage. These trends indicate that nesting terns and plovers are limited by habitat availability.

Colony site turnover rates refer to the annual rate at which birds abandon former nesting sites and pioneer new sites for nesting. Colony turnover rates provide an index of colony stability. High turnover rates indicate low-site stability and may be a function of predation rates, human disturbance, changes in habitat characteristics (i.e., vegetation encroachment, flooding, erosion, etc.), and/or other unknown variables (Cuthbert 1988). Colony turnover rates among nesting least terns and piping plovers on the Missouri River in both North and South Dakota are large (Schwalbach et al. 1988; Mayer and Dryer 1989) when compared to colony turnover rates of coastal or wetlands populations (Burger 1984; Kotliar and Burger 1986; Cuthbert 1988; and Wiens and Cuthbert 1988). Habitat changes caused by System operations contribute to Missouri River colony site instability.

In order for System operations to avoid jeopardy to the interior population of the least tern and the Plains population of the piping plover, management steps must be taken to address the quantity and quality of habitat. Fledge ratios (i.e., the number of juveniles produced annually per nesting pair) are an estimate of productivity. The best scientific information available suggests

Brigadier General Eugene S. Witherspoon

that fledge ratios of 0.70 and 1.44 for terns and plovers, respectively, will maintain a stable population on the Missouri River. The Service believes that, if these fledge ratios are met each year, the Corps will avoid the present jeopardy situation. Fledge ratio estimates shall be based on statistically defensible samples of nesting birds and be representative of productivity for the entire Missouri River population (i.e., samples for fledge ratios should give consideration to the total number of birds (pairs), the total number of colony sites on the entire Missouri River, and the different river reaches (Mayer and Dryer 1988)). The Corps must take the necessary management steps to address quantity and quality of habitat so that fledge ratios are met or exceeded in order to maintain a stable Missouri River population.

The habitat area available to nesting birds may best be described as the scour area which is the area between the mean high and mean low river levels. Although habitat of Missouri River terns and plovers has not been fully evaluated, indications are that most birds nest within the scour area. Nesting habitat characteristics found to be important on the Missouri River, as well as on other river systems, include elevation of nest above river level, substrate, percent vegetative cover, average vegetation height, and distance to forage areas (Dryer and Dryer 1985; Schwalbach 1988). Providing a predator-free and human disturbance-free colony site is also important to productivity of nesting birds.

Optimum habitat may best be described as a complex of side channels and sandbars with the proper mix of habitat characteristics required by the birds. Such sandbar complexes provide regularly scoured habitat for nesting and shallow pools for foraging. Single, large sandbars rarely provide these conditions because they often remain above the scour zone and because the associated channels and side channels are deep and provide little opportunity for foraging. Additionally, mammals sometimes reside on large sandbars and in turn may prey upon nearby tern or plover nests and chicks. Hence, it is important to produce many sandbar complexes rather than a few, large, isolated sandbars. Also, by creating many sandbars distributed evenly throughout the Missouri River System, impacts on the total population would be reduced because devastation of a single colony would represent a much smaller relative loss to the total population. Methods to increase the nesting habitat area available and to enhance habitat characteristics will be necessary to maximize production in order to meet necessary fledge ratios.

Therefore, to preclude jeopardy, it is the Service's scientific judgment that the significant impacts of System operations on terns and plovers need to be eliminated by implementing all of the following alternatives delineated below. These alternatives act together as a functional unit and must be fully implemented as soon as possible to ensure the continued existence of the interior population of the least tern and the piping plover.

1. The Corps should continue to select and schedule flows from main stem dams prior to the least tern and piping plover nesting season (May through August), and other times of the year, as appropriate, in order to meet the needs of the species.

Brigadier General Eugene S. Witherspoon

- a. Operational-caused flooding of nests or habitat should be avoided during the nesting season. Therefore, flows during the nesting season will be set by nest initiation. Once nests have been initiated, flows should not be increased to imperil nests.
- b. Natural nesting habitat should be provided as a priority and other management actions implemented to meet or exceed fledge ratio goals (i.e., 0.70 for terns and 1.44 for plovers).

For example, based on the best year of record (1987) for fledge ratios (0.67 for terns and 1.13 for plovers) below Gavins Point Dam, there were 31 nesting sites with a mean size of 8.13 acres. If additional management actions were taken to enhance habitat criteria (as defined below), fledge ratio goals of 0.70 for terns and 1.44 for plovers could be met. (This example only illustrates possibilities on the Gavins Point reach. Fledge ratio goals are to be met for the entire Missouri River population.)

While the Service can illustrate the best year for the Gavins Point reach because we have the information on hand, we do not have the habitat information needed so that projections for the best years in other reaches can be made. However, the Corps has the capability, available photography, flow data, and cross-sectional information necessary to determine available habitat. Therefore, the Corps should, based in part on past years' information, determine the habitat necessary for each river reach and provide management actions within the Corps' authorities to meet or exceed fledge ratios. Under Section 7(a)(1) of the Endangered Species Act, the Corps shall utilize their authorities by carrying out programs for the conservation of endangered and threatened species.

The Corps should use the following parameters when determining habitat and management actions needed to meet or exceed fledge ratios. The following describe some ideal conditions and the Corps should strive to meet these conditions in order to meet fledge ratio goals.

- (1) Proximity to Forage Habitat - Tern nesting areas should not be greater than 400 meters from an area that provides schooling and feeding fish that are 3 inches in size. Plover nesting areas must include forage areas (i.e., sandbar flats) as a part of the sandbar nesting complex.
- (2) Substrate - Nesting/breeding habitat should consist of very fine to fine sand which is the preferred nesting substrate for terns and plovers. Some gravel is tolerated by plovers since they use it as nest-lining material.

Brigadier General Eugene S. Witherspoon

- (3) **Vegetation (i.e., at nest initiation)** - Percent cover for nesting should be no greater than 25 percent. Optimum percent cover is 10 percent or less. Vegetation height should be less than 10 centimeters.
 - (4) **Elevation of Nest Above River Level** - Nesting areas should be 8 inches or greater above river levels. This will protect nests by allowing for the 2-inch nest depth, any 4-inch rise caused by wind or weather, or other actions that may cause the river to rise in addition to operations. Data collected on the Missouri River shows that, given the opportunity, the majority of birds will nest at 8 inches or greater. However, birds will nest at elevations less than 8 inches, particularly on newly formed (i.e., low elevation) islands. For nests initiated at less than 8 inches (i.e., on sandbars/islands where the 8-inch rule cannot be met), the 8-inch rule will not apply. However, flows should not be increased in order to protect these nests.
 - (5) **Disturbance-Free Area** - Nesting areas should be substantially free from both predation and human disturbance. The Corps should take necessary actions to reduce or eliminate predation and human disturbance during nesting periods.
- c. Due to short-term and long-term adjustments; the Corps cannot make changes in operations to compensate for terns and plovers in all years (e.g., years of high storage and high inflows). When flows below main stem dams may inundate much nesting habitat, other means will be necessary to establish nesting habitat to meet fledge ratio goals. Created habitat should be established to accommodate the following release flows by river reach and to supplement natural habitat required by alternative 1(b) above.

Fort Peck--above 8,500 cfs and below 13,200 cfs
Garrison--above 18,000 cfs and below 31,000 cfs
Fort Randall--above 28,000 cfs and below 38,500 cfs
Gavins Point--above 30,000 cfs and below 39,500 cfs

The created habitat should follow the habitat parameters listed above in 1(b)(1) through 1(b)(5). Acceptable management techniques for habitat creation include (1) replenishment or nourishment of sandbars and islands with a dredging operation to create areas above anticipated high river levels; (2) creation of suitable high elevation nesting habitat (i.e., above river levels) by mechanical (i.e., dredging or clearing) or structural means, such as chevron wing dikes and jetties; (3) creation or enhancement of shallow and backwater areas, off-channel chutes, and flats as foraging habitat; (4) scouring of island and sandbar habitats with high flows prior to nesting season; and (5) use of Schwimmkampen type system (Hoeger 1988) for artificial islands.

Brigadier General Eugene S. Witherspoon

2. Prior to implementing tern and plover management strategies for each operating year, the Corps should demonstrate to the Service's Field Supervisor, North Dakota-South Dakota Field Office, that the planned System operations and tern and plover management strategies will satisfy reasonable and prudent alternatives, reasonable and prudent measures, and strive to meet fledge ratio goals. The Corps should provide this information to, and/or meet with, the Service during development of the draft Annual Operating Plan in the fall and after March 1 when the runoff forecast is made. We anticipate that this will provide enough time to plan or implement operational scenarios that will be necessary for the new operating season.
3. The Corps should compile a separate annual report by December 31 of each year or include in the Annual Operating Plan a report outlining tern and plover management actions, including reasonable and prudent alternatives and reasonable and prudent measures implemented during the operating year, their success in attaining fledge ratio standards and meeting habitat needs, and anticipated actions for the upcoming year. The purpose of this report is to provide the Service and the Missouri River Tern and Plover Management Team the information necessary to evaluate the effectiveness of the Corps' actions. Monitoring information in the report should include:
 - a. Tern and plover fledge ratios;
 - b. Tern and plover population survey results;
 - c. Nest elevations;
 - d. Mapping of nesting habitat, including changes in sandbar morphology during the tern and plover nesting season;
 - e. Estimates of sandbar acreages as modeled by the Corps' cross-sectional data (provided at least every 3 years with updates on the data collection included in the Annual Report);-and
 - f. Historic hourly release data from all dams, including water levels for all reaches for the May 1 to August 30 season.

Further details on items a through f above are found later in this report under "Terms and Conditions for Implementation of Reasonable and Prudent Measures."

4. The Corps should form a Missouri River Tern and Plover Management Team (Team). The Team will consist of Federal and State wildlife agencies.. These agencies will be contacted to verify their willingness to participate.- The annual report (see Reasonable and Prudent Alternative 3) will be provided to this Team (by December 31 of each year). The Team will review the annual report and provide management views to the Corps

Brigadier General Eugene S. Witherspoon

for the following operating season. The Team will meet shortly after March 1 of each year to provide views to the Corps. The Corps will be responsible for scheduling and arranging the Team meetings. Since agency involvement will be voluntary, the Corps will not be responsible for funding other agency participation.

5. The Corps should map, on a periodic basis (at least every 3 years), all essential tern and plover nesting habitat, used by terns and plovers, on the Missouri River as identified in appendix 1 and the recovery plans. This information can, in part, be obtained from cross-sectional information the Corps uses in its hydrology studies and bird-monitoring studies since 1986. The mapping information, in conjunction with the Corps' Satellite Data Collection and Synthetic Modeling (as described in Corps 1989a and 1989b), can be used to determine tern and plover habitat available under different operating scenarios and can be used to assist in establishing and implementing management actions that need to be carried out to meet fledgling ratio goals. Mapping products or updates on data collection will be provided in the annual report (see Reasonable and Prudent Alternative 3).
6. The Corps should continue its "Investigations of Channel Degradation" studies to research the long-term effects of riverbed changes and its impact to tern and plover nesting habitat, forage availability, and forage areas. The results of these studies should be reported each year in the annual report and considered and included as appropriate.

CONSERVATION RECOMMENDATIONS

Section 7(a)(1) of the Act directs Federal agencies to further the purposes of the Act by carrying out conservation programs for the benefit of endangered and threatened species. The following will further the conservation of least terns and piping plovers on the Missouri River.

1. Reservoir populations of least terns and piping plovers should be monitored and surveyed each year rather than just during drought periods (see terms and conditions to implement Reasonable and Prudent Measure 1). This information will help evaluate the System as a whole. Subsampling techniques to obtain statistically valid monitoring surveys are acceptable.
2. Any maintenance dredging operations or dredging permits on the Missouri River (Section 10/404 of the Clean Water Act) should be evaluated by the Corps, in consultation with the Service, for creating tern and plover habitat. Where habitat creation is possible, the Corps will implement actions necessary to create habitat from dredged material.

Brigadier General Eugene S. Witherspoon

3. The Corps should strive to meet Missouri River recovery goals for terns and plovers (800 tern adults for 10 years (USFWS 1989a) and 485 plover pairs (970 adults) for 15 years (USFWS 1988b)) by implementing additional tern and plover management actions, beyond the scope of the reasonable and prudent alternatives, that would further increase productivity (i.e., as indicated by increases of fledge ratio goals).

The Service requests notification of the implementation of any conservation recommendations by the Corps. This courtesy will keep us informed of conservation and recovery actions. Additionally, this will assist the Service and the Corps in making a determination concerning the need for Endangered Species Act Section 10 permits. Section 10 permits are necessary for scientific purposes and enhancement of propagation or survival of listed species (i.e., monitoring and management actions for terns and plovers).

INCIDENTAL TAKE

Section 9 of the Act makes it unlawful for any person to "take" an endangered species. As defined by the Act, the term "take" means "to harass, harm, pursue, hunt, shoot, wound, kill, trap, capture, or collect or attempt to engage in any such conduct" (16 U.S.C. 1532(19)). Further, "harm" is defined to include "an act . . . [that] may include significant habitat modification or degradation where it actually kills or injures wildlife by significantly impairing essential behavioral patterns including breeding, feeding, or sheltering" (50 CFR 17.3). However, Section 7(b)(4) of the Act permits taking of some individuals of an endangered species, if the taking is incidental to the Federal action under consultation, and such incidental taking is not to the degree that the continued existence of the species is likely to be jeopardized (50 CFR 402.14(i)).

The Service has determined that System operations will result in an incidental take of zero for bald eagles. The incidental take for terns and plovers is the amount or extent of anticipated take after the reasonable and prudent alternatives are implemented. For reasons discussed below, incidental take of least terns and piping plovers likely will occur as a result of direct or indirect effects.

Piping plovers and least terns may begin incubation as early as mid-May, but the incubation period begins principally from early to mid-June. Nest initiation by the birds lasts 1 to 2 weeks and is followed by a 25- to 29-day incubation period. Fledging occurs approximately 21 to 26 days after hatching. Renesting may occur such that the birds may not fledge until late August. Thus, the nesting season extends from nest initiation around May 1 until fledging around August 31. Although the Corps has included tern and plover management considerations in the operating plan during the nesting season since 1986, nests and chicks have still been lost (Schwalbach 1988; Mayer and Dryer 1988; Dirks and Higgins 1988; USFWS 1989b). Therefore, it is anticipated that, even after implementation of reasonable and prudent alternatives, a loss of

Brigadier General Eugene S. Witherspoon

birds during the nesting season may occur. While the reasonable and prudent alternatives are designed to avoid jeopardy to the species, losses may be expected because of unanticipated effects of operational changes, human error, or acts of God, such as wind and flood. The following types of unavoidable losses are possible:

1. Taking of eggs and flightless young by flooding or erosion. This has been documented below Gavins Point, Fort Randall, and Garrison Dams;
2. Precluding nesting and renesting of terns and plovers by inundation of or wetting of sandbar, islands, or shoreline nesting habitat. This has been documented below all dams and on reservoirs;
3. Increasing predation on nests, chicks, and adults as a result of reduced nesting habitat or changes in predator/prey relationships;
4. Increasing susceptibility of eggs and young to disturbance and/or destruction by human activities as a result of reduced nesting habitat; and
5. Continued loss of habitat due to degradation and vegetative encroachment.

Having made the determination that incidental take is likely to occur, the Service must provide a statement that specifies the following:

1. The impact (i.e., amount or extent) of anticipated take that will not violate Section 7(a)(2);
2. The reasonable and prudent measures necessary to minimize the amount or extent of incidental take;
3. The terms and conditions, including reporting requirements, that must be complied with by the Corps in order to implement the reasonable and prudent measures; and
4. The procedures to be used to handle or dispose of any individual least tern or piping plover actually taken.

Amount or Extent of Incidental Take

The Service anticipates that, even if reasonable and prudent alternatives are successfully implemented, a minimal amount of incidental take of least terns and piping plovers will occur directly or indirectly as a result of System operations. This take may be in the form of killing, harming, and harassing which includes loss of habitat, loss of individuals, and loss to recruitment.

Brigadier General Eugene S. Witherspoon

The amount of anticipated take likely to occur is unpredictable because it is difficult, if not impossible, to determine if take will always be the result of System operations, other outside System influences, or a combination of actions. Therefore, determination of a specific amount of take is not possible.

We believe the implementation of the reasonable and prudent alternatives will avoid the likelihood of jeopardizing the continued existence of the interior population of the least tern and the Plains population of the piping plover. Additionally, the implementation of the reasonable and prudent measures will minimize the amount or extent of incidental take. In other words, any incidental take that may occur should be offset by the implementation of the reasonable and prudent alternatives and reasonable and prudent measures. Therefore, the Service has determined that the extent of take resulting from the Corps' action or inaction that is not likely to jeopardize the species is that take which will not cause the fledge ratios to drop below 0.70 (terns) and 1.44 (plovers) during a given nesting season. In making the determination, if the results stem from the Corps' action or inaction, the Service will confer with the Management Team. While fledge ratios are based on the best scientific information available, new information may be presented in future years which may necessitate a reconsideration of fledge ratio goals as set above. If new information does become available that reveals effects of the action that may affect the species in a manner or to an extent not previously considered, Section 7 consultation must be reinitiated.

Authorization for incidental take under Section 7 of the Endangered Species Act is not an authorization for take under the Migratory Bird Treaty Act or the Bald and Golden Eagle Protection Act:

Reasonable and Prudent Measures

The Service considers the following reasonable and prudent measures with their implementing terms and conditions to be actions necessary and appropriate to minimize take.

1. All tern and plover nesting habitat on riverine reaches below dams, including the headwaters of Lewis and Clark Lake, as well as reservoir areas during long-term droughts, should be monitored (fledge ratios determined) and surveyed (total adult bird count) on a yearly basis during the May through August nesting season so that operations of dams may continue in a manner to avoid the unnecessary taking of birds. Long-term drought periods are defined as 2 or more years of equal to or less than 45 million acre-feet of year-end storage with less than median inflows.
2. The Corps should continue monitoring daily and hourly fluctuations in releases below all dams or any changes in release due to maintenance or other reasons and use this information in combination with measure 1 above to avoid and minimize take and document unavoidable taking.

Brigadier General Eugene S. Witherspoon

3. The Corps should continue to evaluate operational changes that may be used to avoid take.
4. The Corps should implement public information and education programs to increase public awareness and reduce disturbance to nesting birds.

Terms and Conditions for Implementation of Reasonable and Prudent Measures

In order to be exempt from the prohibitions of Section 9 of the Act, the Corps must comply with the following terms and conditions that implement the reasonable and prudent measures. The Corps is responsible for the funding and means to carry out all reasonable and prudent measures.

Reasonable and Prudent Measure 1 - Productivity and population surveys on reaches below dams shall be conducted each year. Reservoirs shall be surveyed during drought years (less than 45 million acre-feet of year-end storage with less than median inflows) to monitor birds that pioneer exposed reservoir shoreline areas and thus provide accurate estimates of system-wide productivity and population sizes. For example, during the severe drought of 1988 and 1989, 13 percent of least terns and 39 percent of piping plovers nesting within the Missouri River system were found above system dams. Had these birds not been accounted for, population sizes and productivity rates would have been grossly inaccurate.

Population survey information will include (1) the total number of colonies, (2) the total number of birds, and (3) mapping of habitat used by birds (i.e., general location map of colony sites and acreage determination).

Productivity (i.e., nesting and fledge success) estimates will be based on subsamples of the nesting population in each river reach. Consideration in determining subsamples will be given to total number of birds, total number of colony sites, and habitat characteristics. Monitoring information from subsamples will include (1) the total number of nests, (2) the total number of fledged birds per nesting pair and causes of nest and chick loss, and (3) elevation of nests above water levels and distance to water's edge. Calculations for the fledge ratio standard will be a weighted average for the entire river based on the number of pairs.

Survey and monitoring information, in conjunction with the Corps' Satellite Data Collection (as described in Corps 1989a and 1989b), can be used to develop management plans that will avoid taking of birds during the nesting season as well as determine if fledge ratios are met as described in the reasonable and prudent alternatives and requirements for reinitiation of consultation. With such a monitoring program in place, the Corps will know when and how operations may result in take as well as be able to avoid take.

Annual Report - In regard to Reasonable and Prudent Measures 1 through 3, in addition to those items identified in Reasonable and Prudent Alternative 3, the Corps will include the following in the annual report:

Brigadier General Eugene S. Witherspoon

1. Any taking, including loss of eggs, chicks, adults, and habitat, that occurred, including reasons for take and actions to avoid take; and
2. Evaluation of operational efforts to avoid take (habitat and birds).

The above information may be placed in the Corps' Annual Operating Plan.

Reasonable and Prudent Measure 2 - All incidences of take must be documented and immediately reported to the Service (see above annual reporting requirements).

Reasonable and Prudent Measure 3 - If the Corps develops new operational scenarios that were not considered during this consultation, then consultation for these new actions will need to be reinitiated (see above annual reporting requirements).

Reasonable and Prudent Measure 4 - The following actions will be taken to implement this reasonable and prudent measure.

1. Production of a Public Service Announcement (radio release and television video) informing the public of terns and plovers on the river. The Public Service Announcement shall be distributed to radio and television stations within the States bordering the Missouri River to be used at least from May through August. The video shall be available for public use and used in the Corps' project office interpretive programs.
2. The Corps' project offices will engage in intensive public relations efforts for tern and plover conservation to take place on Corps' land, including but not limited to displays, video productions, naturalist talks, information flyers or brochures, information placed in campground notices, and informational posting of boat ramps.
3. Provide personnel and assistance to work jointly with the States and the Service on adequate posting and roping of all nesting areas on the Missouri River. State and Service personnel will each year coordinate efforts with the Corps and determine each agency's level of participation.

Procedures for Handling or Disposing of Least Terns and Piping Plovers

All eggs, chicks, or adults of least terns and/or piping plovers found dead on the Missouri River will be immediately (within 24 hours) reported to the North Dakota-South Dakota Field Office or a law enforcement agent of the Service for instructions on proper disposal.

APPENDIX B

FY 98 PLANS

LEAST TERN AND PIPING PLOVER MANAGEMENT PLAN 1998 MISSOURI RIVER OPERATIONS

OMAHA DISTRICT - CORPS OF ENGINEERS

The US Army Corps of Engineers (Corps) received a jeopardy Biological Opinion on the operations of the Missouri River Main-stem System from the US Fish and Wildlife Service (USFWS) on November 14, 1990. This Biological Opinion (Opinion) concluded that if the operations of the Missouri River remained unchanged, the continued existence of the interior population of the least tern (*Sterna antillarum*) and the Great Plains population of the piping plover (*Charadrius melodus*) would likely be jeopardized. The least tern was listed as federally endangered in 1985. The piping plover was listed as federally threatened also in 1985.

The Opinion included Reasonable and Prudent Measures, Reasonable and Prudent Alternatives, and Conservation Measures, that, if implemented, would preclude jeopardy to these species. Success of implementing the alternatives and subsequent preclusion of jeopardy, is measured by the recruitment of flighted least tern and piping plover chicks on the Missouri River. This management plan outlines the mission that will be undertaken in 1998 by the Corps or those contracted by such, to implement these recovery measures.

MANAGEMENT SITES

1. Fort Peck Reservoir - River Miles 1785.0-1771.0
2. Missouri River below Fort Peck Dam - River Miles 1770.9-1568.1
3. Lake Sakakawea Reservoir - River Miles 1568.0-1389.6
4. Missouri River below Garrison Dam - River Miles 1389.2-1299.1
5. Lake Oahe Reservoir - River Miles 1299.0-1072.0
6. Missouri River below Fort Randall Dam - River Miles 880.0-845.0
7. Lewis and Clark Reservoir - River Miles 845.0-811.0
8. Missouri River below Gavins Point Dam - River Miles 811.0-750.0

Total of 1,035 river miles

WATER LEVEL MANAGEMENT

Following operational projections are based on 1 November 1997 runoff forecasts. Runoff is forecasted for Median (normal), Upper and Lower Quartile (1 in 4), and Upper and Lower Decile (1 in 10) inflows. Reference the 1997-98 Missouri River Main Stem Reservoirs - Annual Operating Plan for further details.

Fort Peck - Releases will be in the 5,000 to 11,000 cubic feet per second (cfs) range in April 1998 and increased to a 9,000 to 14,000 cfs average in May. The median, lower quartile, and lower decile plans show daily releases will be in the 10,500 to 11,000 cfs range from June through August. The upper quartile plan has the June through August release rate at 13,500 cfs. Should greater than upper decile inflows appear likely, project releases may be increased above those flows shown in June or July as the need to evacuate floodwater will be imperative. With normal inflows, Fort Peck reservoir is expected to crest in July at 2240.2 feet mean sea level (ftmsl).

Hourly peaking restrictions of no more than 6 hours of 14,000 cfs will be in place during the nesting season unless inflows are greater than the upper quartile. If flood flows enter the Missouri River below the project during nesting, hourly releases will be lowered to no less than 3,000 cfs in order to keep traditional riverine fish rearing areas continuously inundated while helping to lower river stages at downstream nesting sites.

Garrison - Daily average releases will be increased in May 1998 to prevent arriving birds from initiating nests on low sandbars below the project. The increase will be to 34,000 cfs with the upper quartile plan and 26,000 to 23,000 cfs with plans showing median to lower decile runoff. Should upper decile or greater inflows appear likely, project releases will be at high levels in June as evacuation of flood waters will be necessary. In an effort to provide as much habitat for nesting and brood rearing as possible, upper quartile thru lower decile daily average releases from June thru August will be reduced between 1,000 to 2,000 cfs. As in past years, hourly peaking will be limited to no more than 30,000 cfs for 6 hours if the daily average release is lower than 29,000 cfs. This will limit peak stages below the project for nesting birds.

Lake Sakakawea spring pool elevations will be dependent upon the pattern of inflow. Current projections show the potential for a constant to rising pool from April through July with a lower quartile inflow scenario but declining pool levels with a lower decile runoff. Lake Sakakawea is expected to crest in July at 1845.2 ftmsl. Only very large spring inflows and/or low releases will restrict what should be excellent nesting habitat for plovers and terns on the reservoir.

Oahe - Releases in the spring and summer will back up those from Gavins Point. If flows into the reservoir system are near normal or greater, Oahe's elevation in the spring will likely be steady or rising. The upper decile plan shows April-May elevations below the 1618.6 ftmsl crest reached in 1997. Under the AOP plan, if system inflows are median or lower, the Oahe pool will fall during the summer. With normal inflow Lake Oahe will crest at 1609.9 ftmsl in June.

Fort Randall - Releases from Fort Randall will mirror those from Gavins Point Dam. Hourly releases will be limited to 37,000 cfs, except for upper quartile and upper decile runoff, while

daily average flows may be increased every third day to preserve the capability of sustaining this third day release later in the summer if conditions turn dry.

Gavins Point - For median, lower quartile, and lower decile runoff scenarios there will be an increase in releases by early May, when the birds show up, to the level needed to support navigation in August. Cycling releases every third day is not planned during the 1998 nesting season. Releases during mid May through August for the median and lower quartile are expected to average 34,000 cfs. Lower decile flows for this time period will be near 33,000 cfs. For the upper quartile, releases may range up to 44,000 cfs. For the upper decile, releases may range up to 50,000 cfs. However, release reductions may occur due to downstream flood runoffs. Spilling will be required beginning in summer through fall under upper quartile and upper decile inflow.

The Gavins Point pool will be operated near 1206.0 ftmsl in the spring and early summer. Slight variations will occur day to day due to rainfall runoff. The pool will be increased to elevation 1207.0 ftmsl following the nesting season.

Assuming the reservoir system storage starts near 57.5 million acre feet (MAF) on March 1, 1998, the 1997-1998 forecasted upper quartile and upper decile inflows would result in system storage increases that would require evacuation of stored water from the system during the nesting season. The upper quartile plan reflects mitigating operational adjustments that can be implemented to provide secure nesting habitat through August 14. However, if an upper decile year occurs, the Corps will work closely with the Service and States to ensure the best possible outcome for the birds without jeopardizing our flood control responsibilities (*see Appendix A*). If evacuation of stored flood water endangers the nesting effort on the river, the Corps proposes to collect, captive rear, and release (for research purposes), salvaged eggs and chicks, as was done the past three years (*see Special Projects and Appendix B*).

HABITAT MANAGEMENT

Preliminary evidence of the benefits of hydrograph over the past three years, is providing optimism that habitat for piping plovers and least terns will be very good if not excellent in 1998. This following three years of well above normal system discharges and near record reservoir pool levels. In addition to reduced release forecasts on the lotic reaches of the river, reservoirs are expected to crest much lower than in 1997. With median runoff, Fort Peck Reservoir is expected to crest with a pool elevation of 2240.2 ftmsl, down over 10 feet from a peak of 2250.3 ftmsl during 1997. Fort Peck projected 1998 nesting season release of 11,000 cfs will be one half of the flow (22,000 cfs) experienced on this reach during 1997. Lake Sakakawea Reservoir should peak at 1845.2 ftmsl in late July, down nine feet from the near record 1854.4 ftmsl reached on 1 July 1997. Wave action during the high lake levels at Lake Sakakawea eroded the banks back 20 to 50 feet and removed up to 75 percent of all the trees along the shoreline. Releases from the Garrison Project in 1998 are expected to be 33,000 cfs less than the peak of 59,000 cfs in 1997. Lake Oahe Reservoir's expected crest of 1609.9 ftmsl is nearly 9 feet less than 1997 at 1618.6 ftmsl.

With system storage expected to get to the base of annual flood control pool by March 1, and with normal runoff conditions, habitat management efforts in 1998 will focus on continued development and implementation of an aggressive habitat management plan. This plan will first,

determine the extent of habitat alteration that occurred as a result of the record flows and secondly, to preserve and extend the beneficial habitat modifications into future nesting seasons. Digital orthometric photography flights are planned for the Garrison and Gavins Point river reaches. These flights will provide additional baseline information on which to evaluate habitat change in future years. Efforts will be continued in 1998 to develop a classification system to allow for analysis of the digital ortho photos in a geographical information system. This effort will provide a tool to quantitatively and qualitatively measure habitat availability and to evaluate long-term habitat trends. Additional habitat data from other river reaches including nest locations and historic and current colony sites, will be collected for inclusion in the GIS database using GPS.

Habitat assessment and enhancement activities conducted in 1998 will be integrated into a long term Habitat Conservation and Recovery Plan being developed by the Corps for the Missouri River Basin. Efforts will be undertaken to establish habitat objectives for each reach of the Missouri River determined by recovery population goals set forth in the respective recovery plans. Historic nesting areas will be managed as priority sites to provide seasonal continuity for recruitment potential. Management of these priority sites may include the use of electric mesh fencing, restriction of off-road vehicular traffic, nest caging, etc. This plan will be used to establish goals and direct habitat conservation activities into the future.

Maintenance and enhancement projects during the nesting season will be addressed on an individual project basis. Plans are being developed to create an island complex at Steinke Bay on Lake Sakakawea. This effort would tie an existing island to the enhanced area that was developed in the spring of 1997. A project to develop habitat in partnership with the Bureau of Reclamation and the USFWS-Audubon National Wildlife Refuge on Lake Audubon will be completed in the spring of 1998. This project, using the Corps dredge, will use the spoils from a drawdown channel to create two one-acre piping plover nesting islands behind a water control structure. This ability to control water elevations will prevent inundation during the nesting season and allow for maintenance of the habitat with period inundation. If successful, additional islands may be created or enhanced on Lake Audubon in future years.

BREEDING BIRD CENSUS

Fort Peck Reservoir, Lake Sakakawea, Lake Oahe, Lewis & Clark Lake and the Missouri River reaches below Fort Peck, Garrison, Fort Randall, and Gavins Point Dams will be surveyed to determine the total number of least terns and piping plovers within these areas during the last week of June through the first of July 1998. Census activities will be conducted with the aid of a boat and binoculars or spotting scope. Adults will be counted either while incubating clutches, loafing on the sandbar, or flying overhead near the natal areas. If heavy vegetation exists on an area preventing observation of adults on the ground, birds will be flushed and counted while in the air. On sites with large nesting colonies, where bird activity makes accurate counts improbable, the census count will be recorded as twice the number of active nests plus brooding pairs. Date, time, observers, and site location will be recorded on Corps standardized census record cards. All terns and plovers observed on the reaches having adult plumage will be recorded as breeding adults.

PRODUCTIVITY MONITORING

Productivity monitoring of least terns and piping plovers will be conducted in 1998 on Fort Peck Reservoir (contract with USFWS), Lake Sakakawea, Lake Oahe, Lewis & Clark Lake, and on the Missouri River from Garrison Dam to the headwaters of Lake Oahe, Fort Randall Dam to the headwaters of Lewis & Clark Lake, and Gavins Point Dam to Ponca, Nebraska. A subsample of the Missouri River below Fort Peck Dam, river miles 1714.0 to 1673.0 and 1581.4 to 1568.1, will also be monitored.

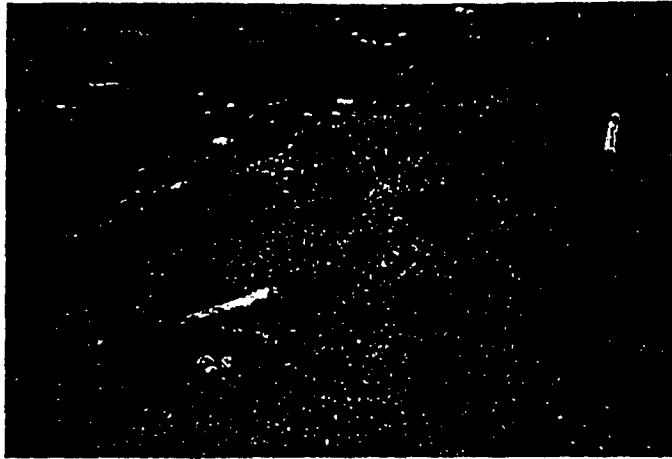
Initial surveys will include a distribution of nesting least terns and piping plovers within each reach. This survey will be conducted by boat on all suitable habitats between May 15 and June 15. Locations of courting or nesting pairs will be recorded on maps and inputted into the Corps' GIS database. Earliest arrival dates in the spring and last observation dates in the fall will be recorded by species, for each reach.

Productivity monitoring of active colony sites will be accomplished on a seven to ten day visitation cycle. Sites will be accessed by boat or vehicle with systematic nest searching and monitoring being conducted on foot. In an effort to preserve embryo viability, surveys will be completed when ambient air temperature is below 90 degrees and nest site disturbance will be limited to 30 minutes or less. Nest locations will be marked with a wooden tongue depressor 2 meters from the nest. Nest data to be collected and recorded on Corps standardized nest cards includes species, habitat type, nest location, nest initiation date, clutch size, number of eggs hatched, determination of causative factor or factors for nest termination, and nest hatching date. Egg floatation to determine nest initiation dates will be used only in cases where nests are located with complete clutches. Excessive handling of early term embryos has been observed, in a captive situation, to result in embryo death.

Chick survival data collected will include a determination of the number of chicks fledged, date of fledging when possible, and a determination of the principle causative factor for chick mortality. Addled eggs and dead least tern and piping plover adults and chicks will be collected and turned over to designated authorities.

Deterrent measures will be implemented on sites where predation is limiting or has historically limited nest success. These measures will include exclosure cages on piping plover nests and electrified predator fencing where appropriate. Other forms of predator deterrence or experimental removal (in coordination with the USDA Animal Control Office) could be implemented following approval by respective State and USFWS offices. Colony sites determined to have a potential for recreational disturbance will be posted with informative restricted access signs and nesting areas will be roped off limits.

Protection of least tern or piping plover nests or chicks threatened by unforeseen natural events, including but not limited to: sandbar erosion as a result of shifting channels (see photo below), abandonment, or rising water levels as a result of a localized rainfall event or upper decile runoff, will be evaluated according to a pre-approved contingency plan (*see Appendix A*). Any eggs or chicks determined to be salvageable will be collected, reared and released according to the captive rearing protocol (*see Appendix B*) for research purposes (*see Special Studies*).



OTHER

Outreach activities will be conducted to increase public awareness and knowledge about least terns and piping plovers and the role they play within the Missouri River ecosystem. These activities could include, but are not limited to, press releases, public service announcements, interviews and tours with local media, interpretive programs, participation in "awareness" days in local areas, and daily public relations. Any disruptive interpretive activity occurring on a colony site will be done concurrently with the 7 to 10 monitoring cycle.

Weekly status reports will be composed during the nesting season. These reports, by reach, will include the number of active nests of each species, number of chicks present of each species, adult census (during weeks of the census), total number of fledged chicks of each species, and any other pertinent data such as status of nests in relation to water elevation, etc. These reports will be forwarded on the following Monday to respective federal and state agencies. Reports will be discontinued when all activity is terminated in each respective reach.

A final report of permitted activities regarding least terns and piping plovers will be submitted to the Field Supervisor, Ecological Services, 420 South Garfield Avenue, Suite 400, Pierre, South Dakota 57501-5408, no later than December 31, 1996.

SPECIAL STUDIES

1. Post-Release Survival Study- Beginning in the spring of 1998 the Corps along with the USFWS and University of Wisconsin-Madison will initiate the Pre-migratory Juvenile Piping Plover Survival Study. This study will determine survival rates of both captive reared and wild reared age 0 piping plovers. Along side of this, efforts will be made to determine any behavioral differences between captive and wild reared piping plovers. In addition to providing funding for this study, the Corps will be collecting and rearing 25 piping plovers to be used in the study.

2. Captive Rearing- During 1998, any additional eggs or chicks determined to be in imminent danger of being inundated by high releases experienced during flood storage evacuation service levels* (flood control operations) not needed for the Post-Release Survival Study, will be collected (anticipated in 1998 only if upper decile runoff). All efforts will be made to retain viability of natural nesting sites (*see appendix A*). Field crews will monitor nest site elevations.

Nests predicted, through UNET modeling, to be inundated by a scheduled flood control operation release will be collected, along with nests predicted to be flooded by rising reservoir pool elevations. Attending adults will be allowed to incubate the eggs until just prior to the inundating flow. This will ensure that birds will not attempt to renest on the jeopardized habitat prior to it being covered. Egg collections, incubation, rearing and release will be conducted according to approved protocols (*see appendix B*). The Corps continues to seek advice from appropriate outside interests concerning the captive rearing facility and husbandry of the birds.

* Criteria for scheduling of storage evacuation service level (flood control operations) (*see plate 44 in the Master Water Control Manual*). The Corps of Engineers maintains and operates six Missouri River main stem dams for multi-purpose use. The flood control function of the system is a priority consideration while scheduling releases. Other multi-purpose regulation must be consistent with the flood control objectives. There will be times when the service provided to other purposes must be modified in the interest of flood control.

Gavins Point Project located near Yankton, South Dakota is the final project on the river and serves as a regulation reservoir. Releases from Gavins Point are termed "service levels" and are determined based on detailed runoff projections. Basic to utilization of the "service-level" concept is a definition of the minimum and maximum service levels that can be maintained while sustaining the design functions of the system. The minimum open water level which will sustain the navigation function throughout the Missouri River navigation project is a 29,000 cfs service level. Reductions below the minimum service level on the basis of potential flood control enhancement which may (or may not) occur, will not be made unless it appears evident that such reductions would have only a minor adverse effect upon other system functions. The full-service level of downstream open-water flows is at 35,000 cfs. The initial increase above this full-service level has been designated as the expanded full-service level and consists of extending the navigation season 10 days. Additionally, as a storage evacuation measure, winter releases averaging 20,000 cfs can be scheduled from Gavins Point.

Full service winter level corresponds to a 15,000 cfs average winter release from Fort Randall. Experience has indicated as mentioned above, that the winter release level can be increased to a 20,000 cfs release rate from Gavins Point with only a modest increase in the potential for downstream ice-jamming. During these winter months, multi-purpose releases are restricted due to the possibility of ice formation and consequent severe loss in channel capacity. Since the ability to evacuate system storage is severely restricted during this time, the necessary increase in system release rates for flood storage evacuation purposes (system storage no higher than 57.2 MAF on March 1st) above rates necessary to meet other multi-purposes, will largely be made during the open water season.

Selection of appropriate service levels for flood storage evacuation purposes, in excess of the full-service levels, are dependent upon: (1) anticipated runoff from the drainage area above the main stem system; (2) depletions to this runoff that can be expected to occur prior to the time this runoff appears as inflows to the main stem reservoirs; (3) current total storage in the main stem system and in major tributary reservoirs above the main stem system; (4) and evaporation from the main stem reservoirs.

Plate 44 in the current Master Manual has been developed for definition of the service level at any time throughout the year. The "water supply" to be used for service level definition is a combination of (a) forecast runoff above Gavins Point Dam from the current date through December; (b) current system storage; and (c) tributary reservoir storage deficiency. The tributary reservoir storage deficiency at any given time is subtracted from the concurrent storage total in the six-reservoir main stem system and the resulting storage is then added to the forecasted remaining calendar year runoff to obtain the current water supply value which, in turn, is used to enter Plate 44 to determine the appropriate service level on which system releases should be based. One further adjustment to "water supply" needs to be made and it is (d) main stem storage reduction which is based on the fact that the total storage capacity of the main stem system has been reduced by about 2 million acre-feet due to sedimentation since plate 44 was originally conceived. Additionally, as a conservative measure prior to 1 July, a selected service level greater than full-service level should be 5,000 cfs less than indicated by use of plate 44.

Essentially, Plate 44 consists of storage (water supply) curves that can be expected to occur if the indicated service level is sustained through the remainder of the open water season and comparable releases are also maintained through the winter to the succeeding March 1st.

APPENDIX A

CONTINGENCY PLAN FOR PROTECTION OF LEAST TERN AND PIPING PLOVER NESTS AND CHICKS

The Corps of Engineers will carry out the following contingency plan for the protection of least tern and piping plover nests and chicks threatened with termination due to natural events or inundation due to poor nest selection under normal system operation, or flood control operations. All efforts will be made to protect nest site viability in the wild prior to collection for captive rearing. Nests will only be collected immediately preceding the inundating release to restrict renesting efforts on unstable habitats. Listed below is a sequential operating plan for nests and chicks threatened by rising water levels. All guidelines are subject to State and Fish and Wildlife Service permit approval and conditions.

NESTS

1. Consult with Reservoir Control Center for water level management options.
 - a. Exercise options if available.
 - b. If options not available, step 2.
2. Move nest to higher ground that will not be inundated until after the chicks anticipated fledging date.
 - a. If successful continue to monitor nest.
 - b. If nest cannot be successfully moved, step 3.
3. Elevate nest using a tire or other object if rise in water is expected to be short term.
 - a. If successful continue to monitor nest.
 - b. If water rise is expected to be long term or if nest cannot be raised, step 4.
4. Evaluate the option of egg removal and captive rearing.

If option 4 is to be exercised, the US Fish and Wildlife Service and appropriate state agencies will be contacted for coordination and concurrence.

 - a. Remove eggs to captive rearing facility to be incubated and raised for release into the wild.
 - b. Remove eggs to captive rearing facility to be incubated and raised for research that will aid in meeting the recovery goals of these species.

CHICKS

1. Consult with Reservoir Control Center for water level management options.
 - a. Exercise options if available.
 - b. If options not available, step 2.
2. Remove chicks and place on adjacent islands within sight of adult birds, if sites unavailable, step 3.
3. Remove chicks to captive rearing facility.

If option 3 is to be exercised, the US Fish and Wildlife Service and appropriate state agencies will be contacted for coordination and concurrence.

 - a. Remove chicks to captive rearing facility to be raised for release into the wild.
 - b. Remove chicks to captive rearing facility to be raised for research that will aid in meeting the recovery goals of these species.

APPENDIX B

CAPTIVE REARING PROTOCOL

CAPTIVE REARING

Captive rearing will be conducted at the Corps of Engineers (Corps) facility at the Gavin's Point Project Office. The facility consists of a main building containing a brooding area, egg handling, incubation, and diet preparation laboratory and an office (see attached facility plans). Outdoor flight pens are attached to the rear of the facility. The building is designed to facilitate the captive rearing of interior least terns and piping plovers in a safe, clean, and healthy environment. The interior walls of the facility are sealed to allow for pressure washing and disinfection of all surfaces. The building and outdoor pens are serviced by raw Missouri River water, treated water, and enclosed sewer.

Visitation protocols are established to limit visitor contact with the birds. Facility technicians are required to wear separate footwear in the brooder area other than that worn outdoors or in the office. Technicians also wear lab coats confined to bird handling areas. Foam alcohol hand creams are used to minimize contamination when handling birds.

Staff from the National Biological Service, Madison Wildlife Health Laboratory were consulted on building design and facility protocols.

COLLECTION

Eggs collected at distances greater than 50 miles from the incubation laboratory at the Gavin's Point Project in Yankton, South Dakota, are placed in a portable incubator to maintain egg viability on route to the lab. Eggs collected within close proximity (less than 50 miles) of the facility, are collected and transported from the field to the laboratory in modified polystyrene or pressed cardboard egg cartons. This allows for the collection operation to be expedited as quickly as possible while maintaining egg viability. Eggs are cleaned, weighed, and candled prior to being placed in the incubator. Any nonviable eggs are removed and sent to the Fish and Wildlife Service (Service) for disposal.

INCUBATION

Viable eggs are placed in a Petersime Model I incubator located in the lab room (see building diagram). Piping plover and least tern eggs are incubated concurrently in the same incubator. The Petersime incubator features a redwood housing, thermostatic thermometer with backup, 150 degree rotational drum egg rack with 2000 egg capacity, paddle fan, and hatcher box. Humidity is controlled by varying the surface exposure of the water pan. Temperature is monitored using the standard dry and wet bulb Fahrenheit thermometers provided by the Petersime Company. Incubator operation settings are set to simultaneously, as closely as possible, meet the requirements of both species.

Dry Bulb Thermometer 99.5 degrees F

Wet Bulb Thermometer 87 degrees F

Relative Humidity 59-60%

Eggs are individually identified by writing a coded number on each shell with a nontoxic felt tipped pen. Eggs are candled and weighed Tuesday, Friday, and Sunday of each week. Weighing allows monitoring of embryo weight loss during the incubation period. Proper humidity regulation should result in 10-10.5 percent fresh egg to hatch weight loss for piping plovers and 11-13 percent fresh egg to hatch weight loss in least terns. Candling enables data to be collected on embryo development and allows observers to accurately determine time to remove eggs from the rotating drum. A second Petersime incubator is used to hatch eggs. Once membrane crowning is observed in the air cell, eggs are to be removed from the incubation incubator and placed in the hatcher incubator. This allows for sufficient time prior to the embryo penetrating the membrane into the air cell, at which time the unhatched chick is susceptible to suffocation if the egg is continually rotated. Humidity within the hatching incubator are to be increased to 65-70 percent. Expected pip to hatch times are 12 to 48 hours for piping plovers and 12-24 hours for least terns. Birds are to be allowed to dry off and then be individually identified with a colored plastic leg band prior to placing them in the brooder box.

BROODING AND FEEDING

After 10 to 12 hours in the hatcher box, or when chicks are completely dried off and are able to stand, the hatchlings will be removed from the hatcher and weighed to determine hatching weight prior to being placed in the brooder box. Every effort will be made to segregate chicks from like broods into individual brooders to prevent any implications that may arise from cross-sibling imprintation. Brooder boxes will be constructed of 7/16ths AC plywood with the smooth side turned in to prevent any injuries from splinters. Box interiors will be sealed with a food grade polyurethane to reduce bacterial contamination and aid in box sanitation. Boxes will be built in 4' X 8' complexes with each individual box being 2' X 2' square and 16 inches high.

Brooder floors will be covered with indoor/outdoor carpeting which will in turn be covered with sand to protect the young birds' feet. Least tern brooders will be provided with a sand simulated nest bowl and an attending adult decoy. Piping plover brooders will have a brood pouch constructed of terry cloth towel for brooding security. Brood boxes will be covered with a fabric top and will be heated with incandescent light bulbs with brooder hoods.

Boxes will be heated to 95-98 degrees F for three to five days with the temperature slowly being decreased as birds began to feather and thermoregulate themselves. Hatchlings will be kept in the brood boxes until their feather tracts are fully feathered (approximately 12-14 days) and they are able to fully thermoregulate. Boxes will be cleaned and disinfected Monday and Thursday of each week using Germacert[™] nontoxic disinfectant. Chicks will be weighed during the brooder cleaning to track weight gain and adjust diet to ensure proper nutrition.

Recommended Diets:

- Piping Plovers 1-3 days old - mini meal worms, brine shrimp, blood worms, pinhead crickets, black worms, and fly larvae. Supplement with commercial chick starter.
- Piping Plovers 3+ days old - regular meal worms, brine shrimp, blood worms, wax worms, baby crickets, and locally collected insects. Supplement with a poultry starter for filler.
- Least Terns 1-3 days old - locally seined fish fry 1 to 1.5 centimeters in length.
- Least Terns 3+ days old - endemic forage fish, i.e., shiners, mooneye, fathead minnow, freshwater drum, etc., not to exceed 3-5 cm.

Piping plovers will be fed a complete diet containing items above that are available from a local supplier along with insects trapped on-site nightly. Dry food items will initially be sprinkled on the floor of the brooder box to stimulate the young chicks' pecking behavior. Once chicks become accustomed to foraging, all food will be provided in plastic petri dishes to aid in box sanitation. Piping plover chicks will be provided with an unlimited food supply along with a 50-50 mix of CaCO_3 and Petaminetm bird vitamins to meet additional nutritional requirements. Diets will be monitored and adjusted according to a nutritional assay of food items obtained for least tern and piping plover forage.

Least terns will be fed several species of endemic forage fish fry until three days of age at which time they will be switched to a variety of locally seined river forage fish and fathead minnows purchased from a local supplier. Available fish species will be analyzed for thiaminase and a variety of fish will be used as feed so thiamin deficiencies can be avoided. When available fishes nutritional composition is insufficient to meet thiamin requirements, a thiamin supplement will be provided. Fish supplied locally from seines or a supplier will be held at Gavin's Point National Fish Hatchery then placed on ice prior to being fed to the birds. While in the brooder boxes forage for the least terns will be hand fed using a white surgical glove and forceps. All feeding will be conducted in complete background darkness to minimize the association between humans and feed. Once the birds become accustomed to grabbing the fish, fish will be provided in a drop in pan filled with water to train the birds to self feed. Least terns will be fed every two hours from 7:00 a.m. to 9:00 p.m. or more frequently as needed.

Both species will be given unlimited water in shallow petri dishes. Brooder boxes will be rolled outside each day for a minimum of two hours. This will ensure vitamin D is metabolized and that bone development deficiencies are avoided.

All feeding utensils and petri dishes will be disinfected after each feeding. The brooder and laboratory will be disinfected at least once per day with a broad spectrum disinfectant. All personnel feeding or handling chicks or otherwise doing general maintenance in the brooder room or lab will apply foamed alcohol hand cream to prevent cross contamination.

When chicks are 12-14 days old and are able to feed and thermoregulate themselves, they will be transferred to the outdoor flight pen. The outdoor pen is 48 feet by 60 feet and contains 6, 20 feet by 20 feet warm release pens. Three of these pens are designed for plovers and contain 15 feet by 20 feet sand pads and 10 feet by 20 feet beach/pool habitats which gently slope from ½ inch to 6 inches deep. The remaining three pens, designed for terns, contain a 10 feet by 20 feet sand pad but the pool habitat slopes from ½ inch to a maximum depth of 1 foot. The pool habitats are individually contained and receive continuous flow of raw river water.

The outdoor pen's exterior walls and dividers are constructed of a four foot high concrete stub wall. Pen floors and pool bottoms are continuous concrete that abuts an elevated center walkway. Eight foot chain link fencing is attached to the stub wall and is lined with shade netting. Eleven foot high exterior walls support a vinyl coated wire mesh roof which rises to 25 feet at the center, providing opportunity for terns to aerially forage over the pool habitat.

Prior to new broods being placed in pens, the pens will be bleached where possible and sand areas raked and exposed to ultraviolet light.

Food will be provided to the pens from the center walkway access until chicks are fully feathered, self-foraging, and are capable of sustained flight. At this time they will be captured with a drop net and banded for release.

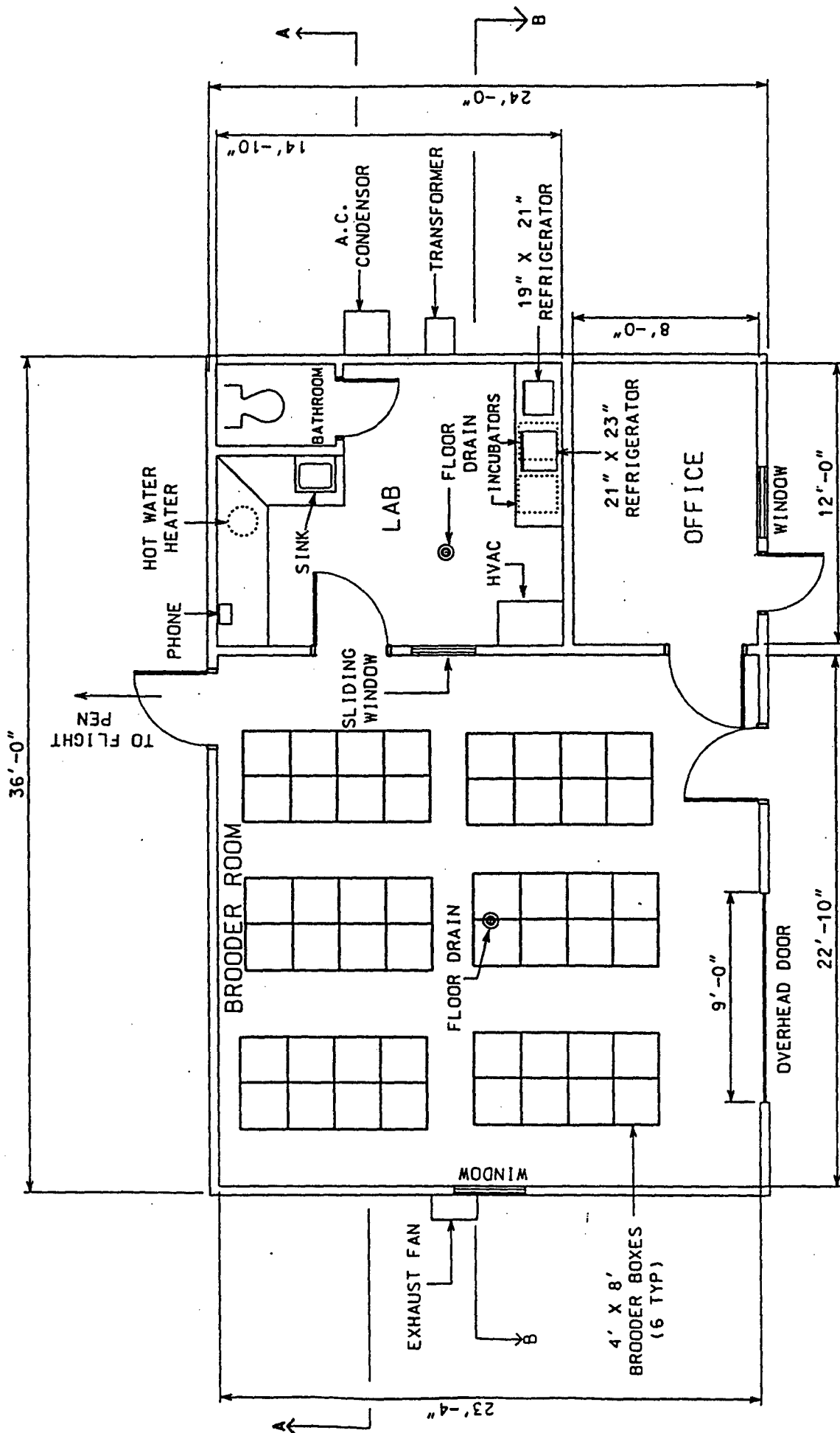
RELEASE AND POST-RELEASE MONITORING

Least terns will be banded with size 1A or 1B steel serially numbered Fish and Wildlife Service bands. Piping plovers will be banded with size 1A or 1B stainless steel serially numbered Service bands. A colored flag (UV stable, Darvic tm plastic manufactured by A.C. Huges) will be applied to the upper leg opposite the Service band.

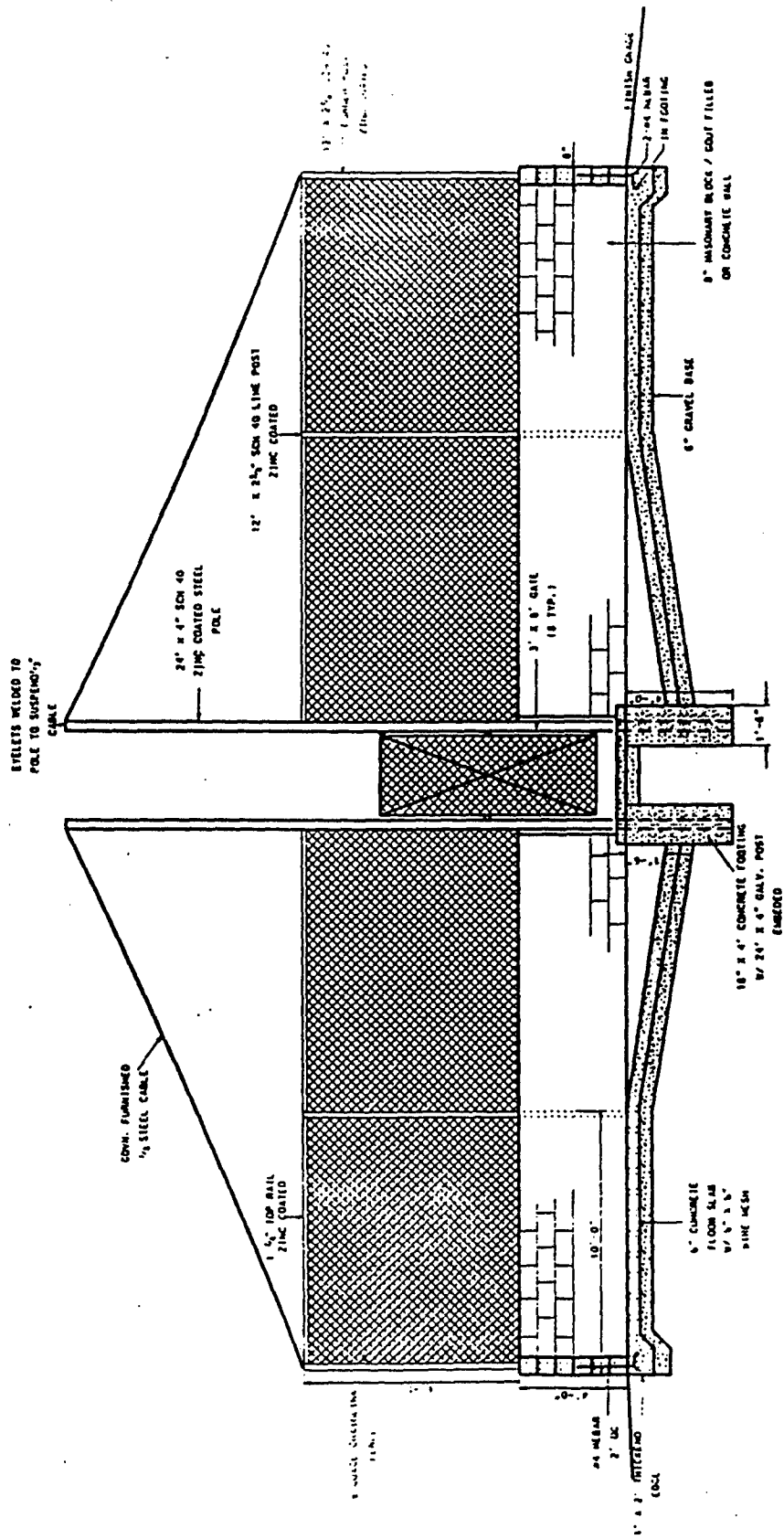
Banded fledglings will be released on sandbar habitat that provides a secure release substrate for a minimum of two weeks post-release. These habitats will be determined to have sufficient elevation to remain exposed during increases in discharges and also will have an available food source for the fledglings. Close coordination with State and other Federal agencies will be undertaken to ensure suitable habitats are located for release sites prior to birds fledging. Many of the constructed sites built by the Corps in previous years below Gavin's Point Dam should provide suitable release substrates.

Piping plover chicks of individual broods will be grouped and released onto sandbars with no existing nesting or brooding piping plover adults or released into staging flocks of young-of-the-year flighted piping plover chicks. Least tern chicks of individual broods will be grouped and released near active least tern colonies where young-of-the-year least terns are fledging and beginning to forage for themselves, or released into staging flocks of young-of-the-year flighted least tern chicks.

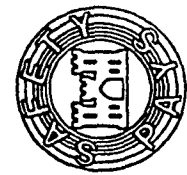
Least tern and piping plover chicks will be transported to release areas in modified poultry shipping crates. Chicks will be hard-released onto the release areas. Releases will be monitored in conjunction with the Post-Release Survival Study. Efforts will be coordinated through the



PLAN VIEW
CAPTIVE REARING BUILDING



CROSS SECTIONAL END VIEW A-A
T&E FLIGHT PEN



DESIGNED BY		CHECKED BY		APPROVED BY	
DATE		DATE		DATE	
U.S. Army (Indicate District) Corps or Component Organization					
GAVINS POINT DAM TANK TON. SO T&E FLIGHT PEN					
PROJECT NO.		DRAWING NO.		SHEET NO.	
OF		OF		OF	

APPENDIX C

PERMIT ACTIVITY REPORT



United States Department of the Interior

FISH AND WILDLIFE SERVICE
Mountain-Prairie Region

IN REPLY REFER TO:

RW/ND/SD
Subpermit 93-07
Mail Stop 60130

MAILING ADDRESS:
Post Office Box 25486
Denver Federal Center
Denver, Colorado 80225-0486

STREET LOCATION:
134 Union Blvd.
Lakewood, Colorado 80228-1807

MAY 5 1998

Colonel Robert D. Volz
Omaha District Commander
U.S. Army Corps of Engineers
215 North 17th Street
Omaha, Nebraska 68102-4978

Dear Colonel Volz:

This letter authorizes you and designated members of your staff, as subpermittees (subpermit 93-07) under authority of permit PRT-704930, to conduct the following activities through December 15, 1998, for the purpose of scientific research under the following conditions.

Survey for piping plovers (Charadrius melodus) and interior least terns (Sterna antillarum athalassos) in nesting areas along the Missouri River and its tributaries and elsewhere in South Dakota, Montana, North Dakota, and Nebraska to determine habitat use, nesting success, and productivity.

1. Surveys for piping plovers and interior least terns will be conducted when the ambient temperature is below 90 degrees Fahrenheit.
 - a. Surveys of each colony will be completed within 20 minutes.
 - b. You may conduct up to three surveys to determine when the first territorial or breeding piping plovers or interior least terns have occupied a breeding territory. When the first territorial birds are found on a colony, the condition of 2.b. will take effect.
 - c. Piping plovers and interior least terns will be observed from a distance of 200 feet or greater during nesting and brood rearing.
 - d. Nesting piping plovers and interior least terns and those observed returning to their nests are not to be disturbed.

However, when unforeseen events cause rising or excessive water levels or dangerously eroding sandbars that threaten piping plover and interior least tern nests, eggs, or chicks, after you have evaluated the situation and have received concurrence from the Fish and Wildlife Service's Field Supervisor, Ecological Services, 420 South Garfield Avenue, Suite 400, Pierre, South Dakota 57501-5408, telephone (605) 224-8693, you are authorized to relocate piping plover and interior least tern nests, eggs, and chicks as provided below.

- (1) Move nests to higher ground that will not be inundated until after the eggs' anticipated hatching date.
 - (2) You may elevate nests above the anticipated high water mark using a tire, section of culvert, or other container filled with soil and/or rock. Material used should be of a similar texture to that of the nest scrape.
 - (3) Relocate nestlings or flightless chicks from nests surrounded by water or those on raised structures to suitable nearby habitat.
 - (4) You may manipulate nests, eggs, and chicks using other proven or reasonable techniques approved by the Field Supervisor (see the address above).
 - (5) The techniques and procedures used when moving nests, eggs, or nestlings; the circumstance that required moving them; captive rearing and release into the wild; the monitoring efforts used to determine the effectiveness of these actions; and the results of the monitoring must follow the enclosed "Least Tern and Piping Plover Management Plan, Omaha District, Corps of Engineers, 1998 Missouri River Operations" and must be documented and included in the annual reports of activities conducted under this subpermit.
- e. Surveys may be conducted using motor vehicles, canoes, motor boats, or on foot. Searchers will remain at a distance of 30 feet or more from nests and will not handle eggs or chicks, except where otherwise noted in this subpermit.
- f. Nest sites may be signed or fenced as needed to protect them from livestock and recreational vehicles.
2. Conduct surveys for broods and nesting success.

- a. Nests may be checked for success or failure at 5- to 7-day intervals.
- b. No more than eight visits to determine reproductive success will be made to any colony during a breeding season.
- c. Collect addled eggs or eggshells from interior least tern and piping plover nests for research or analysis by the Service or a laboratory approved by the Field Supervisor. All eggs should be placed in a plastic bag with a label including date and location and should be stored in the freezer until they can be shipped unless notified otherwise by the Field Supervisor. Eggs from differing clutches should be clearly distinguished. Information about the number of eggs, their fertility, predators, etc., should be provided in your annual reports of activities.

Piping plover egg samples can be sent directly to Dr. Susan Haig, U.S. Geological Survey, Biological Resources Division, Forest and Rangeland Ecosystem Science Center, Oregon State University, 3200 S.W. Jefferson Way, Corvallis, Oregon 97331. Dr. Haig should be contacted at (503) 750-7482, and arrangements should be made before shipping.

Interior least tern samples can be sent directly to Jodi Whittier, Oklahoma Cooperative Fish and Wildlife Research Unit, 404 Life Sciences West, Oklahoma State University, Stillwater, Oklahoma 74078-3051. Ms. Whittier should be contacted at (405) 744-6342, and arrangements should be made before shipping.

- d. Collect any dead piping plovers or interior least terns found during surveys for autopsy or research analysis. Contact the Field Supervisor for specific instructions on disposition of birds. Information about the cause of death, if known, predators, etc., should be provided in your annual reports of activities.
 - e. Eggs and dead birds collected pursuant to condition 2.c. and 2.d. must be delivered to the nearest Service Ecological Services Office. Please call the Field Supervisor (telephone number above) for the location of the nearest office and/or if you have any questions about how to store or ship the eggs or birds.
3. You may mark nests using inconspicuous dull wooden stakes, i.e., tongue depressors, wooden dowels, or small branches from brush or trees. Markers will be placed at least 30 feet from any nest.

4. When first found or if nests are threatened, you may sign or fence nest sites to protect them from livestock and recreational vehicles. Nests also may be covered using 3- by 3-foot square, 2-foot 6-inch high woven wire exclosures having 2-inch diameter wire mesh to protect them from predators.
5. Build predator exclosures at piping plover and interior least tern nest sites.
6. Use flashing strobe lights mounted on fence posts or other structures to discourage predators.

Lights may be configured to light selected parts of nesting areas and should be timed to flash out of synchrony as described in the previously provided report "Strobe Lights Deter Predators."

7. Stage of incubation may be determined using egg floatation techniques described in:

Schwalbach, M.J. 1988. The Conservation of Least Tern and Piping Plover Along the Missouri River and Its Major Western Tributaries in South Dakota. MS Thesis. South Dakota State University; Brookings, SD.

However, this technique will only be used in cases where nests are found with complete clutches. In Montana, not more than one fertile egg per nest may be floated to estimate the stage of incubation.

8. Except in the state of Montana, you may number eggs as needed using a No. 2 pencil or nontoxic felt-tipped pen as mentioned in:

Mitchell, C.A. and T.W. Custer. 1986. Hatching Success of Caspian Terns Nesting on the Lower Laguna Madre, Texas, USA. Colonial Birds. 9(1). Pp 86-89.

Persons working with eggs and caging materials will reduce human scent by washing in scent canceling soaps before any activities on an active nest colony.

9. Piping plover and interior least tern chicks may be photographed but not handled, except as stipulated in condition 1.d.
 - a. Pre-flight juveniles will not be disturbed if ambient temperature exceeds 90 degrees Fahrenheit.

- b. No pre-flight juveniles will be pursued within the borders of the nesting colony.
 - c. Juveniles should not be pursued for photographing individuals.
10. Before release of piping plovers held in captivity pursuant to condition 1.d., attach a serially numbered Service band and a "flag" or color band combination to the leg of each bird.
- a. Size 1A stainless steel serially numbered Service bands will be used.
 - b. Apply a light blue flag or other color approved by the Field Supervisor on the leg opposite the Service band. Use information previously enclosed concerning materials, preparation of flags, and method of application.
 - c. Only flags and color bands made of UV stable, Darvic tm plastic manufactured by A.C. Hughes should be used. Color banding combinations should be coordinated with the Migratory Bird Management Office and the Field Supervisor to ensure that combinations are not in conflict with other piping plover projects.
 - d. Juvenile piping plovers 16 days and older may be color banded.
 - e. There will be no stacking of bands.
11. Before release of interior least terns held in captivity pursuant to condition 1.d., attach a size 1A stainless steel serially numbered Service band to the leg of each bird.
- a. Color bands not to exceed two total may be used to distinguish individual interior least terns.
 - b. Interior least terns 12 days and older may be color banded.
 - c. Only color bands made of UV stable, Darvic tm plastic manufactured by A.C. Hughes should be used. Color banding combinations should be coordinated with the Migratory Bird Management Office and the Field Supervisor to ensure that combinations are not in conflict with other interior least tern projects.

Coverage under this subpermit is provisional under the following restrictions.

1. You will obtain the required permits and conduct your activities in compliance with the Service's Bird Banding Laboratory and all the laws and regulations of the States of South Dakota, Montana, North Dakota, and Nebraska and those Federal agencies upon whose lands you work. This subpermit does not grant the right of trespass. Permission must be obtained from private landowners or the land management agency to enter and work on their land.
2. All activities will be coordinated with the Field Supervisor (see the address above). You are to inform that office of all activities conducted under this subpermit.
3. In the event that a piping plover or interior least tern is accidentally injured, you must immediately cease activities and contact the Field Supervisor (see address above) to obtain information on the closest authorized animal rehabilitator. Additionally, if plovers or terns are injured or killed, you should also contact the appropriate Senior Resident Agent for Law Enforcement. For the Montana Agent, call (406) 247-7355. For the North Dakota/South Dakota Agent, call (605) 224-1001. For the Nebraska/Kansas Agent, call (316) 788-4474. Once the situation has been remedied the Service, after analysis of the circumstances surrounding the injury, may reauthorize or deny additional activities under this subpermit.

Any threatened or endangered species that is accidentally killed (taken) while conducting activities authorized by this subpermit must be reported within 24 hours to the Field Supervisor (see address above). Species and/or the parts of species that are taken remain the property of the Service. If the disposal of species is not identified in the above conditions, the Service's Assistant Regional Director, Law Enforcement, P.O. Box 25486, Denver Federal Center, Denver, Colorado 80225, telephone (303) 236-7540, will make the final determination on disposition of any threatened or endangered species taken during authorized activities.

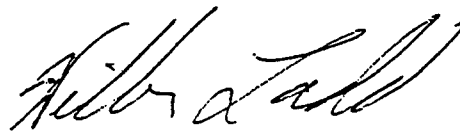
4. Collection of feathers, eggs, carcasses, and parts thereof are authorized under the Migratory Bird Treaty Act. Disposition of these items shall be at the instruction of the Field Supervisor (see the address above), who will coordinate with Law Enforcement personnel in the Regional Office.
5. If you wish to continue work with endangered or threatened species after expiration of this subpermit, your request for subpermit renewal must be received by the Field Supervisor (see address above) on or before November 15, 1998. Meeting this requirement allows you to continue

authorized activities until your renewal application is acted upon. If this requirement is not met, the subpermit becomes invalid on the date of expiration. You may appeal any permit modification if you believe it is unacceptable. The Code of Federal Regulations, Title 50, Section 13.32, appeal procedure is enclosed for your guidance. Any new activities or changes in activities with threatened or endangered species will require that your subpermit be amended. You are not authorized to conduct any new activities or to change any permitted activities until you have requested and have received a new or an amended subpermit.

6. Annual reports of all activities conducted under the authority of this subpermit must be submitted to the Field Supervisor (see address above) by December 31, 1998. Failure to submit annual reports will invalidate this subpermit. Your reports should include complete accounts of all activities conducted under this subpermit. A renewal request for 1999 will not be processed until the 1998 annual report is received.
7. A copy of permit PRT-704930 is enclosed; the conditions of this permit must be adhered to. This letter and the enclosed copy of permit PRT-704930 must be in your possession, or in the possession of designated members of your staff, while conducting all authorized activities.

Please reference subpermit 93-07 when submitting renewal or amendment requests and activity reports. If you have any questions about this authorization or need additional information, please contact the Field Supervisor (see address above).

Sincerely,

A handwritten signature in black ink, appearing to read "Keith Tall". The signature is fluid and cursive, with the first name "Keith" and last name "Tall" clearly distinguishable.

Assistant Regional Director
Refuges and Wildlife, ND/SD

Enclosures

**MISSOURI RIVER
INTERIOR LEAST TERN AND PIPING PLOVER
PERMIT ACTIVITY REPORT**

including
Population Status and Productivity Summary



**US Army Corps
of Engineers**
Omaha District

DECEMBER 1998

TABLE OF CONTENTS

Introduction	1
Management Units	2
Missouri River Study Areas - Map	4
Management Unit Descriptions & Historical Background	5
1998 Survey and Monitoring Activities	16
Habitat Conditions & Bird Arrivals	16
Adult Census	21
Productivity & Recruitment of Flighted Chicks	25
Habitat Management	35
Management Actions	36
Public Awareness	40
Specimen Collection for Contaminate Analysis	40
Special Studies	41
Banded Bird Sightings	42
Acknowledgments	45
Appendix A - Nest Record & Adult Census Cards	
Appendix B - Site by Site Productivity Records	
Appendix C – Niobrara River Study Abstract	
Appendix D - Nesting & Adult Census Site Maps	
Appendix E – T&E Personnel Pictures	

1998 AT-A-GLANCE

INTERIOR LEAST TERN (*STERNA ANTILLARIUM*)

MISSOURI RIVER POPULATION SURVEY & MONITORING

	ADULT CENSUS	MONITORED ADULT CEN	NESTS	NESTS HATCHED	NEST(a) SUCCESS	EGGS	AVE CLUTCH SIZE	EGGS HATCHED	MONITORED CHICKS FLEDGED	TOTAL CHICKS FLEDGED	FLEDGE(b) RATIO	COLLECTED NESTS	COLLECTED EGGS	COLLECTED RELEASED
Fort Peck Lake	4	4	2	1	50.0	6	3.00	3	0	0	0.00	0	0	0
Fort Peck River	25	21	11	8	72.7	28	2.55	20	16	19	1.52	0	0	0
Lake Sakakawea	23	23	20	15	75.0	50	2.50	32	12	12	1.04	0	0	0
Garrison River	141	141	73	57	78.1	181	2.48	140	107	107	1.52	0	0	0
Lake Oahe	110	101	48	40	83.3	126	2.63	102	65	71	1.29	0	0	0
Fort Randall River	64	64	33	31	93.9	83	2.52	76	30	30	0.94	0	0	0
Lewis and Clark	120	120	72	60	83.3	176	2.44	145	140	140	2.33	0	0	0
Gavins Point River	144	144	83	70	84.3	214	2.58	178	168	168	2.33	0	0	0
TOTAL	631	618	342	282	82.5	864	2.53	696	538	547	1.73	0	0	0

a = Nests per 100 attempts

b = fledged chicks per pair of adult birds (Does not include collected fledged.)

1998 AT-A-GLANCE

PIPING PLOVER (*CHARADRIUS MELODUS*)

MISSOURI RIVER POPULATION SURVEY & PRODUCTIVITY MONITORING

	ADULT CENSUS	MONITORED ADULT/GEN	NESTS	NESTS HATCHED	NEST(S) SUCCESS	AVE CLUTCH SIZE	EGGS HATCHED	CHICKS FLEDGED	MONITORED CHICKS	TOTAL CHICKS FLEDGED	FLEDGED ^b RATIO	COLLECTED NESTS	COLLECTED EGGS	COLLECTED RELEASED
Fort Peck Lake	4	4	2	1	50.0	4.00	4	0	0	0	0.00	0	0	0
Fort Peck River	4	4	3	2	66.7	3.00	7	2	2	2	1.00	0	0	0
Lake Sakakawea	119	119	64	46	71.9	3.17	137	74	74	74	1.24	0	0	0
Garrison River	74	74	32	27	84.4	3.72	93	68	68	68	1.84	0	0	0
Lake Oahe	98	95	41	33	80.5	3.39	110	51	51	52	1.06	0	0	0
Fort Randall River	33	33	14	11	78.6	3.71	39	21	21	21	1.27	2	8	8
Lewis and Clark	84	84	49	40	81.6	3.53	134	103	103	103	2.45	3	12	11
Gavins Point River	49	49	28	20	71.4	3.57	70	54	54	54	2.20	1	4	2
TOTAL	465	462	233	180	77.3	3.45	594	373	374	374	1.61	6	24	21

a = Nests per 100 attempts

b = fledged chicks per pair of adult birds (Does not include collected fledged.)

SUBJECT: Annual report of activities conducted by the U.S. Army Corps of Engineers under endangered species research permit PRT-704930, subpermit 93-07.

PURPOSE: Document activities conducted under subpermit 93-07, condition 6: pg. 6, and provide 1998 adult population and recruitment estimates for least terns (*Sterna antillarum*) and piping plovers (*Charadrius melodus*) on the mainstem Missouri River. Data presented in this report is standardized with data previously collected on the Missouri River. This report summarizes data from eight U.S. Army Corps of Engineers Project and Natural Resource Offices, a contracted tribal game and fish department and a contracted U.S. Fish and Wildlife Service-Ecological Services Office. If additional information is required for comparative studies, unassimilated field office reports are available from the Operations Division of the Omaha District, U.S. Army Corps of Engineers, Gavins Point Project, PO Box 710, Yankton SD 57078.

INTRODUCTION: The least tern and piping plover historically have used the Missouri River and its tributaries as breeding grounds. In 1985 the interior population of the least tern was listed as federally endangered and the northern Great Plains population of the piping plover was listed as federally threatened. On November 14, 1990 the U.S. Army Corps of Engineers (Corps) received a jeopardy Biological Opinion (Opinion) from the U.S. Fish and Wildlife Service (USFWS) concerning the operations of the Missouri River Mainstem System (System). This Opinion concluded that the current operations of the System would likely jeopardize the continued existence of the interior population of least tern and the northern Great Plains population of piping plover.

The Opinion included Reasonable and Prudent Measures, Reasonable and Prudent Alternatives, and Conservation Measures that, if implemented, would preclude jeopardy to these species. The preclusion of jeopardy was based on increasing recruitment as measured by fledge ratios. Recovery is monitored through annual censuses of breeding populations and productivity surveys.

Since receiving the Opinion, the Corps has initiated several research projects and has implemented management techniques to increase annual recruitment of piping plovers and least terns. The 1998 nesting season marks the sixth consecutive year that Corps of Engineers personnel have conducted census and monitoring activities for least terns and piping plovers on the System. Corps staff from five Project Offices and three satellite Natural Resource Offices conducted the work on seven of eight designated reaches of the Missouri River. Adult population census and productivity monitoring of nesting sites were

conducted along nearly 850 miles of river and reservoir shoreline. In addition, the Corps provided funding for scope-of-work contracts with the USFWS-Montana Ecological Services Billings sub-office and the Cheyenne River Sioux Tribe Game, Fish, and Parks. The Billings sub-office surveyed and monitored the Fort Peck Lake reach and the Cheyenne River Sioux conducted the adult census on a portion of Lake Oahe.

Standard record cards revised in 1997 were again used for the 1998 field season. (See Appendix A for examples of nest cards and adult census cards.) A training session for seasonal staff was held at Riverdale North Dakota in June. This session covered field techniques, chick identification, juvenile aging, permit compliance, and record keeping. Thirty people involved in the adult surveys and productivity monitoring attended the training. Pre-nesting season and post-nesting season meetings were held with permanent staff in April and October in Bismarck, North Dakota.

The following report documents all activities undertaken under the conditions of the endangered species research permit (Regional Blanket Permit PRT-704930, subpermit 93-07). This permit was issued to Colonel Robert Volz of the U.S. Army Corps of Engineers, Omaha District, Omaha, Nebraska, by the U.S. Fish & Wildlife Service, Region 6, to work on least terns and piping plovers on the Missouri River during 1998.

MANAGEMENT UNITS

The Missouri River contains eight least tern and piping plover management units. These units include all known piping plover and least tern nesting sites within the mainstem Missouri River. Management units are based on geographic location, hydrographic characteristics, and the ability to control or influence water elevations through dam releases. These eight management units include four riverine or lotic reaches and four reservoir reaches. The management units, the agency and office conducting the surveys and monitoring activities during 1998, and the inclusive river miles of survey and productivity activities are listed below.

1. FORT PECK LAKE

USFWS Charles M. Russell National Wildlife Refuge-Fort Peck Office
Billings Suboffice, Ecological Services

Adult Census: River Miles 1785.0-1771.0

Productivity: River Miles 1785.0-1771.0

2. MISSOURI RIVER BELOW FORT PECK DAM

Corps of Engineers Fort Peck Project, Fort Peck MT,

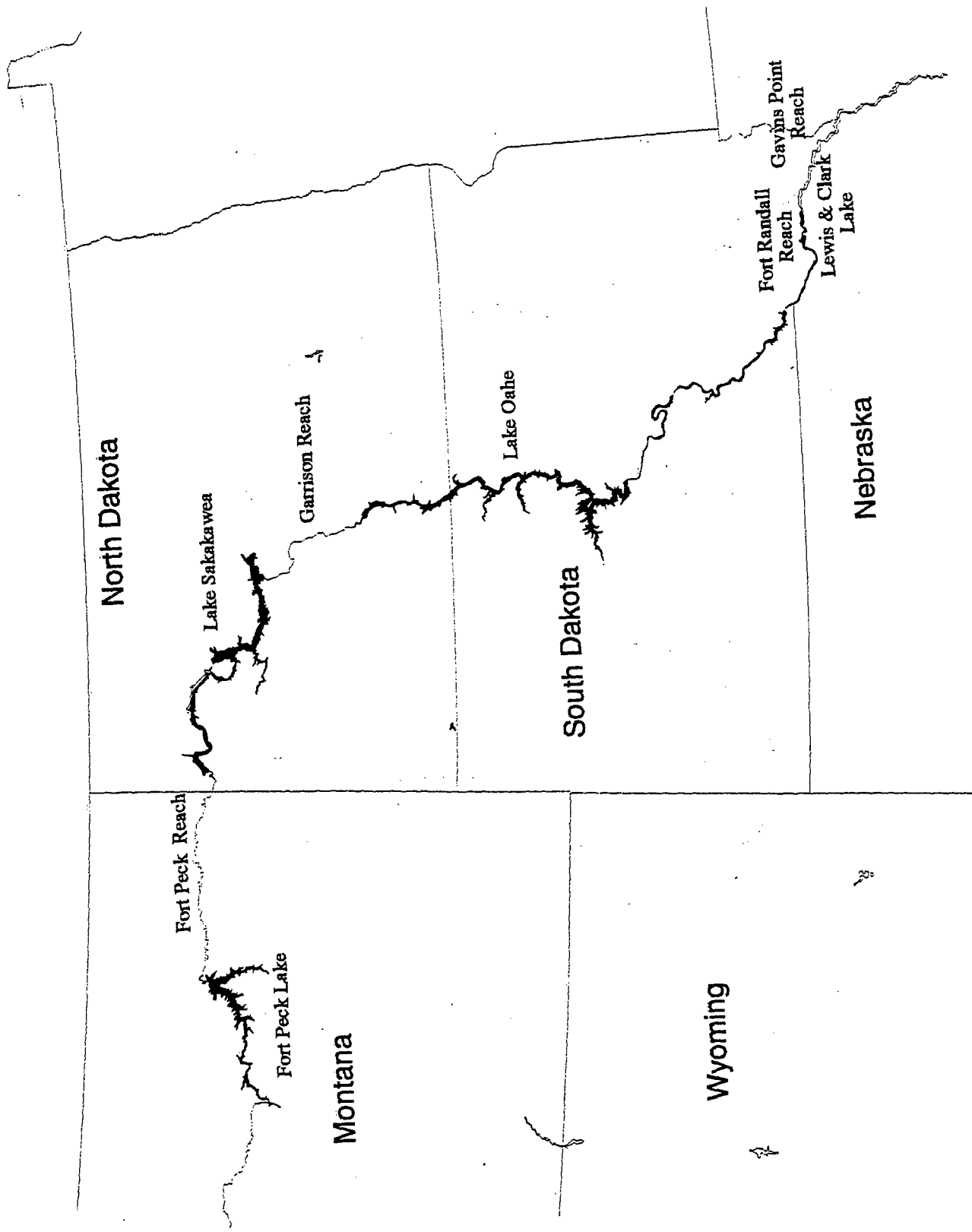
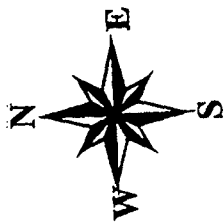
Adult Census: River Miles 1771.0-1581.5

Productivity: River Miles 1714.0-1673.0

- Corps of Engineers Garrison Project Williston Resource Office, Williston, ND
Adult Census: River Miles 1581.5-1568.0
Productivity: River Miles 1581.5-1568.0
3. LAKE SAKAKAWEA
Corps of Engineers Garrison Project Williston Resource Office, Williston, ND
Adult Census: River Miles 1568.0-1480.5
Productivity: River Miles 1568.0-1480.5
Corps of Engineers Garrison Project Riverdale Resource Office, Riverdale, ND
Adult Census: River Miles 1480.5-1389.6
Productivity: River Miles 1480.5-1389.6
4. MISSOURI RIVER BELOW GARRISON DAM
Corps of Engineers Garrison Project Riverdale Resource Office, Riverdale, ND
Adult Census: River Miles 1389.6-1355.0
Productivity: River Miles 1389.6-1355.0
Corps of Engineers Oahe Project Bismarck Resource Office, Bismarck, ND
Adult Census: River Miles 1355.0-1299.0
Productivity: River Miles 1355.0-1299.0
5. LAKE OAHE
Corps of Engineers Oahe Project Bismarck Resource Office, Bismarck, ND
Adult Census: River Miles 1299.0-1232.0
Productivity: River Miles 1299.0-1232.0
Corps of Engineers Oahe Project Mobridge Resource Office, Mobridge, SD
Adult Census: River Miles 1232.0-1165.0
Productivity: River Miles 1232.0-1165.0
Corps of Engineers Oahe Project Pierre Resource Office, Pierre, SD
Adult Census: River Miles 1165.0-1072.0
Productivity: River Miles 1165.0-1072.0
6. MISSOURI RIVER BELOW FORT RANDALL DAM
Corps of Engineers Fort Randall Project Office, Pickstown, SD
Adult Census: River Miles 880.0-845.0
Productivity: River Miles 880.0-845.0
7. LEWIS AND CLARK LAKE
Corps of Engineers Gavins Point Project Office, Yankton, SD
Adult Census: River Miles 845.0-811.0
Productivity: River Miles 845.0-811.0
8. MISSOURI RIVER BELOW GAVINS POINT DAM
Corps of Engineers Gavins Point Project Office, Yankton, SD
Adult Census: River Miles 811.0-750.0
Productivity: River Miles 811.0-750.0

The following page shows the location of the management units within the Missouri River Basin.

MISSOURI RIVER STUDY AREAS



MANAGEMENT UNIT DESCRIPTIONS & HISTORICAL BACKGROUND

Missouri River: The Missouri River and its tributaries dominate the hydrology in the north central region of the United States. The Missouri begins at the confluence of the Madison, Jefferson, and Gallatin Rivers near Three Forks, Montana. The river travels 2,400 miles north, east, and southeasterly before joining with the Mississippi River just north of St. Louis, Missouri. The Missouri and its tributaries drain a basin of over 529,000 square miles, including 9,700 square miles in Canada. The Missouri River Basin (Basin) includes all of Montana and Wyoming east of the Continental Divide, most of North Dakota and South Dakota, all of Nebraska, the northern halves of Kansas and Missouri, the northeast part of Colorado, and small portions of western Iowa and southwestern Minnesota.

Topographically, the northern Rocky Mountains dominates the western part of the Basin. Going east the Rockies give way to the Great Plains which encompasses more than half of the Basin. These high, relatively flat lands in turn slope down to the central lowlands in the eastern part of the Basin. The Yellowstone River is the major tributary of the Missouri in the northern plains. The Yellowstone River, originating in northwestern Wyoming, wanders northeasterly through Montana to its confluence with the Missouri just east of the Montana-North Dakota state line. Other important tributaries of the upper Missouri include the Milk, Little Missouri, Cheyenne, White, James, and Niobrara Rivers.

The Missouri River and its ecosystem have seen dramatic changes since the coming of the first Europeans in the 1700s. Originally, the river meandered through a broad riverine/floodplain forest ecosystem forming braided channels, sandbars, sloughs, chutes, islands, and backwater areas. This system was periodically refreshed by the Missouri's high propensity for flooding. In a typical year, river flows would rise in March and April from the snow melting on the Great Plains. There would be a second higher peak in June as the snowmelt from the Rockies reached the river. Flows steadily declined through the summer and fall. It has been estimated that the Missouri would flood on average two out of every three years. This flooding provided the cycle of habitat renewal necessary for least terns and piping plovers by scouring sandbars of vegetation, building up existing sandbars, and creating new islands.

Though flooding revitalized the Missouri's ecosystem, it proved disastrous to the towns and industries that sprung up along the river. Following a series of destructive floods on the Missouri and Mississippi Rivers in the 1930s, Congress passed the Flood Control Act in 1944. This legislation authorized the construction of dams on the Missouri and its tributaries as a means of obviating the flood threat. The centerpiece of the construction was

the building of five major dams on the Missouri. These dams; Gavins Point on the Nebraska-South Dakota border, Fort Randall, Big Bend, and Oahe in South Dakota, Garrison in North Dakota, and the previously constructed Fort Peck Dam in Montana, became the primary mechanism for controlling floods on the Missouri. To provide for safe navigation, the Missouri was channelized and dredged from Sioux City, Iowa to St. Louis.

These construction projects accomplished the goals of reducing flooding and providing a reliable navigation season on the Missouri River. However, these actions have had an adverse effect on least tern and piping plover recruitment on the river. The reservoirs, impounded behind the dams, inundated hundreds of miles of the river. The loss of sediment transport has greatly reduced sandbar and island regeneration and has resulted in rapid degradation of the riverbed. The elimination of periodic flooding has reduced the river's ability to scour vegetation from the sandbars, leading to vegetation encroachment on many of sandbars located downriver from the dams. The channelization of the Missouri from Sioux City to its confluence with the Mississippi has despoiled it as a natural system.

Fort Peck Lake Reach: Located in eastern Montana, the Fort Peck Lake Reach contains the eastern portion of Fort Peck Lake. The lake was created in 1940 with the completion of Fort Peck Dam. The lake varies in size from 212,000 acres at 2234 feet mean sea level (msl) to 240,000 acres at 2246 feet msl. The primary water source of the reach is the Missouri River, draining nearly 57,500 square miles of Montana and Canada into the lake.

Rolling mixed-grass prairie hills and "breaks" of badlands topography containing trees and shrubs dominate the land surrounding Fort Peck Lake. Piping plover and least tern habitat consists of sand and gravel beaches along the active erosion zone of the lake, and islands formed by washed prairie hills. The size of the beaches varies with the elevation of the lake.

The climate of the Fort Peck Lake Reach is typical of the western Great Plains region, with hot summers, and cold, dry winters. Prolonged droughts and frequent shorter periods of deficient moisture, interspersed with periods of abundant precipitation are characteristic of the area. The average annual temperature is 43 degrees Fahrenheit, with summer daily high temperatures ranging in the 80s and 90s. The reach is a semi-arid region, with normal annual precipitation between ten to twelve inches, 80% of which occurs during April to September. Hail commonly occurs in the area. The prevailing winds during April to October are predominately west to northwesterly, and east to southeasterly. Summer winds are highly variable since they are subject to passing storm systems and fronts.

Recreational use on Fort Peck Lake includes fishing, both from shore and boats, pleasure boating, water skiing, camping, and swimming. Project lands surrounding the lake are leased to the U.S. Fish & Wildlife Service forming the Charles M. Russell National Wildlife Refuge. Beyond the lake, livestock production and some farming, are the dominant industries.

Piping plovers begin arriving at Fort Peck Lake in mid May, the least terns during the first two weeks in June. The lake is marginal habitat for plovers and terns and nesting sites are usually restricted to the eastern part of the lake. The thirteen year average for the annual adult census is thirteen plovers and four terns.

Fort Peck River Reach: The Fort Peck River Reach of the Missouri River, begins at Fort Peck Dam then travels 203 miles in an easterly direction to the western boundary of Lake Sakakawea in North Dakota (RM 1568.0). The primary water sources for this reach are releases from Fort Peck Dam, and inflows from the Milk (RM 1761.5), Poplar (RM 1678.9), and Yellowstone (RM 1582.0) Rivers.

The majority of the sand/silt sandbars used by terns and plovers in the upper reach are situated downstream of the Milk River confluence. The Poplar River also transports a considerable amount of suspended fine sediments. Pre-dam flows in this reach were generally high early in the season (spring) and steadily declining throughout the summer season. High spring flows, in addition to ice, would scour the river basin, maintain the aggradation/degradation cycle of sediments in the river and prevent the establishment of emergent vegetation on seasonally exposed sandy areas. This would provide habitat ideal for tern and plover nesting. The construction of Fort Peck Dam has altered these seasonal flow rates. Releases from Fort Peck Dam normally average between 7,000 - 10,000 cfs during the nesting season.

On the lower part of the reach, the Yellowstone River can greatly influence Missouri River flows below the confluence of the two rivers. The Yellowstone drains over 70,000 square miles. It is the longest unrestricted river in the United States with only one dam, the Yellowtail, located on a major tributary, the Bighorn River. Spring runoff from the Yellowstone watershed can dramatically change this portion of the Missouri's appearance from year to year. High runoff will inundate many of the sandbars and islands. Conversely a low runoff exposes miles of sandy beaches.

Prairie uplands, rugged breaks, and cottonwood (*Populus deltoides*) bottomlands dominate the reach. The glaciated created portions of the area are characterized by level to rolling uplands dissected by coulees and gullies. Low hills, rugged breaks and badlands

characterize the unglaciated areas. The north side of the river tends toward a broad floodplain while the south side is a combination of floodplain and bluffs dissected by coulees. Vegetation consists of a combination of mature floodplain cottonwood forest, woody draws and mixed-grass prairie. Several sandbars and inter-channel islands dot this reach. Vegetation on the islands includes grasses, forbs, shrubs, and willows. Some islands will contain mature cottonwoods.

The climate of the Fort Peck River Reach is similar to that of the Fort Peck Lake Reach and typical of the western Great Plains region. The average annual temperature is 43 degrees Fahrenheit, with summer daily high temperatures ranging in the low 80s and 90s. The reach is a semi-arid region, with normal annual precipitation of 11.5 inches, 80% of which occurs during April to September. Runoff is rapid due to the fine texture and high clay content of the soil. Thus, sudden rainstorms can cause major flooding on the watershed. Hail is common within the reach. The prevailing winds during April to October are predominately west to northwesterly, and east to southeasterly. Summer winds are highly variable since they are subject to passing storm systems and fronts.

Activities within the reach include boating, recreation, livestock grazing, bank stabilization projects and water intakes for irrigation. Recreational use includes shore and boat fishing, pleasure boating, and canoeing.

Least terns and piping plovers arrive on the reach the last week in May into the first week in June. Annually, around twelve plovers will be found during the adult census. For terns, the twelve year average is 76 terns seen during the adult census.

Lake Sakakawea Reach: The Lake Sakakawea Reach consists of Lake Sakakawea and Lake Audubon. Both were created following construction of Garrison Dam. Garrison Dam was constructed in the 1950s and is fifth in ascending order of six mainstem dams on the Missouri River. The dam is located in central North Dakota at RM 1389.8. From the dam Lake Sakakawea extends 178 miles in a northwesterly direction ending at River Mile 1586.0. Lake Audubon is located ten miles northeast of the dam and was created by the placement of a three-mile long causeway across the eastern end of Lake Sakakawea. At full pool (1850 feet mean sea level) Lake Sakakawea covers 364,000 acres, making it the largest man-made lake in the United States. Lake Audubon covers 17,500 acres.

Runoff from 181,400 square miles of the Missouri River Basin drain into Lake Sakakawea. The Yellowstone River furnishes about 50% of the 17,500,000 acre feet of water that annually flows into the headwaters of Lake Sakakawea. The Missouri River provides 42%. The remaining 8% flows into the lake by way of the Little Missouri River,

Little Muddy River, White Earth River, Douglas Creek, and Shell Creek. The major source of water for Lake Audubon is Lake Sakakawea through a pumping station maintained by the Bureau of Reclamation.

The pool elevation in Lake Sakakawea varies from an average low of 1834.4 feet msl in March to an average high of 1842.3 feet msl in July. Though uncommon, yearly elevation changes of more than fifteen feet have occurred on the lake. These changes can drastically alter the amount of habitat available to shorebirds including the least tern and piping plover. The elevation of Lake Audubon is kept stable throughout the spring, summer, and fall under a cooperative agreement between the Bureau of Reclamation, the U.S. Fish & Wildlife Service, and the North Dakota Game & Fish Department. The lake elevation is drawn down in the fall to curb winter shoreline erosion.

The topography of the Lake Sakakawea Reach is dominated by the Missouri Trench through which flows the Missouri River. The trench is three to five miles wide with a maximum elevation between 200 and 250 feet. Throughout its length, intermittent stream valleys and coulees draining into the Missouri dissect the trench.

The Lake Sakakawea Reach is located in the high latitude continental climate. Summer maximums range in the mid 80 degrees Fahrenheit though temperatures above 100 degrees Fahrenheit are not uncommon. The prevailing wind is from the west to northwest. The wind averages around eleven miles per hour but winds have been clocked at greater than seventy miles per hour. The precipitation averages around fourteen to fifteen inches per year with 75% occurring during the months of April through September.

The land surrounding the Lake Sakakawea Reach is almost entirely owned by the federal government and administered by the U.S. Army Corps of Engineers. Land use activities include wildlife management, livestock grazing, farming, and recreation. Potential conflicts with terns and plovers can exist with any of these activities. Habitats used by piping plovers and least terns within Lake Sakakawea include both sand and gravel beaches along the active erosion zone of the lake, and islands formed by washed prairie hills.

Piping plover reproductive chronology on Lake Sakakawea is similar to that observed on the adjacent prairie coteau habitats, with the birds arriving and initiating nests during early May. Least terns arrive a month later during the first three weeks in June. Nesting sites are widely scattered, dependent on availability of habitat, with the possibility of both species found anywhere on the lake except the Little Missouri Arm. Lake Sakakawea has never supported large nesting concentrations of least terns, with the thirteen year average being about 16 breeding adults. The thirteen year average for plovers seen during the adult census is 78. This is the third highest average of the eight reaches. The

number of plovers seen can fluctuate significantly, depending on the elevation of the lake during the nesting season.

Garrison River Reach: The Garrison River Reach of the Missouri River begins at Garrison Dam, then travels south ninety miles to the northern boundary of Lake Oahe, located just south of Bismarck, ND (RM 1299.0). The primary water source for this reach comes from releases at Garrison Dam. Two tributaries, the Knife River at RM 1374.5 and Heart River at RM 1311.3 contribute minimal amounts except for occasional flooding within their watersheds.

Bank stabilization projects and the lack of sediment transport through Garrison Dam has resulted in significant riverbed degradation. About 50% of the shoreline between the Garrison Dam and Bismarck ND have some form of bank protection (abutments, jetties and riprap). Cutbanks ranging in height from 5 to 35 feet occur along much of the upper portion of the reach. Surrounding topography consists of a relatively flat floodplain, containing remnant tracts of cottonwood forest, with adjacent river breaks and upland mixed grass prairie. Nesting islands and sandbars begin at RM 1380.0 and continue downstream throughout the stretch.

As a result of channel degradation and the elimination of spring scouring flows, nearly all of the islands along the Garrison River reach have become vegetated. Many of the islands have mature woody vegetation including sand willows and cottonwoods. The vegetation along the riverbanks consists of old growth cottonwoods or some type of agriculture regime, grazing and farmlands.

The Garrison River Reach, like Lake Sakakawea, is located in the high latitude continental climate. The prevailing wind is from the west to northwest. The precipitation averages around fourteen to fifteen inches per year with 75% occurring during the months of April through September.

Other impacts to plovers and terns within the reach include recreation, agriculture, bank stabilization projects, water intakes, and housing developments. Recreational use includes fishing, pleasure boating, jet skis, canoeing, water skiing, beach sports, swimming and sunbathing. Fishing enthusiasts may be found all over the reach. The other recreational activities are concentrated in areas next to the Bismarck-Mandan metropolitan area. Likewise, the majority of the riverside housing developments are found around and above Bismarck-Mandan. Other riverside communities may be found near Stanton, Washburn, and Wilton, ND.

Least terns and piping plovers arrive on the reach in late May. Both species begin initiating nests during the first three weeks of June. This portion of the Missouri has historically been an important nesting area for both species. The thirteen year average for the adult census conducted along the Garrison Reach is 160 least terns and 106 piping plovers. Major nesting sites for the two species along this part of the Missouri include islands and sandbars at RM 1374.5, 1369.8, 1364.5, 1354, 1335, and 1308.5.

Lake Oahe Reach: Lake Oahe was created with the impoundment of the Missouri River by the Oahe Dam. The dam is located in central South Dakota five miles north of Pierre at RM 1072.3. Lake Oahe runs north for 227 miles to Bismarck ND (RM 1299.0). At full pool (1617.0 feet msl), Lake Oahe covers 360,000 acres, making it the second largest man made lake in the United States. Runoff from 243,490 square miles of the Missouri River Basin drains into Lake Oahe. The major source of water to Lake Oahe is the Missouri River. Other tributaries include the Cannonball, Grand, Moreau, and Cheyenne Rivers.

The Missouri River and land surrounding Lake Oahe have undergone extensive change since the completion of Oahe Dam. Land use activities surrounding the lake include wildlife management, livestock grazing, farming, and recreational developments. Potential losses of plover and tern habitat on the reach include livestock use of beaches favored by the birds, agricultural development, and recreational use of shoreline and island beaches.

The topography of the reach consists of rolling mixed-grass prairie interspersed with woody draws. This gives way in the north to the relatively flat Missouri River floodplain where active sediment deposition is occurring in the river/reservoir delta region. Piping plover and least tern habitat availability in the reach fluctuates with the lake level. Sandbars and a dredge spoil island provide habitat in the upper end of the lake, while gravel and sand eroded out of the banks along reservoir shorelines, provides nesting substrate on the lower lake. The few islands that are on the lake are heavily vegetated. Least tern and piping plover habitat availability in the upper thirty miles of the lake is optimal when Oahe's pool elevation is below 1604.0 feet msl and discharges from Garrison Dam are less than 15,000 cfs. At higher pool levels and or higher discharge rates, most of the sandbars become inundated. Lake Oahe contains several long peninsulas affording piping plovers and least terns extensive shoreline for nesting during periods of average and low pool elevations. Current operating procedure for Lake Oahe includes a peak pool elevation in May followed by slowly declining levels, presenting favorable nesting conditions in most years.

Piping plovers begin arriving on Lake Oahe during the first week in May. Nest initiations by plovers on Lake Oahe begin in early May and continue through the third week

in June. Least terns return to Lake Oahe and begin nesting during the first three weeks of June. Very few nests are found in the middle of the lake but the terns utilize shoreline beaches along the Cheyenne River Arm. The most important nesting site on Lake Oahe is Dredge Island at RM 1270.0. This site has been home to nearly 50% of all nests found on the Lake since surveys began. Lake Oahe harbors substantial numbers of both species with a thirteen year average of 97 terns and 67 plovers being counted during the annual census. Although significant numbers of terns have been observed on this reach nesting success has been below average with only 23% of the nests successfully hatching.

Fort Randall River Reach: The Fort Randall Reach begins at the Fort Randall Dam in southeast South Dakota at RM 880.0. The river travels in a southeasterly direction 35 miles to the western boundary of Lewis & Clark Lake (RM 845.0). Most of the water for this reach is through releases from Fort Randall Dam.

The Missouri here is free flowing, however controlled releases from Fort Randall Dam have eliminated periodic flooding for most of the reach. The topography varies from relatively flat floodplain on the eastern shore to high wooded bluffs on the western shore. The bluffs in turn are dissected by coulees and ravines that lead down to the river.

The floodplain forest is the dominant ecosystem along the eastern shore of the river. However in many areas farmlands have eliminated the forest from the banks. Oaks and cedars on the bluffs dominate the western shore. Without the scouring by floods, vegetation has become established on most of the islands in the reach. These include grasses, forbs, and shrubs. Some islands have developed stands of mature cottonwoods.

The reach is located in an area typical of a continental-interior climate with great variations in weather not only from season to season but also from year to year. Hot summers and cold winters are typical with humidity ranging from an average of 60% in the afternoon to 80% during the night and early dawn. The frost-free period in the area averages 155 days. Precipitation in the region averages 25 inches of rainfall annually with the majority of it occurring during the spring and summer months. The average seasonal snowfall for the reach is around 30 inches. Thunderstorms can be expected to occur about 45 days out of the year. Tornado and severe weather pass through the region infrequently. Temperatures can exceed 100 degrees Fahrenheit in summer and drop to below 0 degrees in the winter months. The average summer daily temperature is 72 degrees and the average winter daily temperature is 24 degrees. The winds are predominantly from the south-southwest during the summer and from the northwest during the winter months. Wind speeds vary greatly, and it is not uncommon to have winds up to 50 mph during the year.

Human activities within the reach include recreation, agriculture, bank stabilization projects, and housing developments. Recreational use includes fishing, both from shore and boats, pleasure boating, jet skis, canoeing, swimming and sunbathing. In the Niobrara Scenic River Designation Act of 1991 this 35 mile portion of the Missouri was designated a National Recreation River. With this designation increased recreation pressure on the reach is expected. With the construction of the Fort Randall Dam and the elimination of a flood threat, several summer home communities have sprung up along the river. The establishment of these homes, primarily on the Nebraska side of the river, and the development of agriculture tracts along the river has led to an increased demand for more bank stabilization projects.

Piping plovers arrive on the Missouri River below Fort Randall Dam during the first two weeks of June. Least terns arrive during the second and third week of June. Historically the birds have congregated on just two islands, located at River Miles 869.0 and 866.7. This portion of the Missouri has not been a major area for the two species. The thirteen year average for the annual adult census shows 9 plovers and 21 terns.

Lewis & Clark Lake Reach: Lewis & Clark Lake was created with the impoundment of the Missouri River by Gavins Point Dam. Gavins Point Dam was constructed in the 1950s and is first in ascending order of six mainstem dams on the Missouri. The dam is located on the South Dakota-Nebraska border four miles west of Yankton, SD at RM 811.1. From the dam Lewis & Clark Lake extends thirty-four miles in a westerly direction ending at RM 845.0. At full pool (1208.0 feet msl) the lake covers 28,000 acres.

Water from 279,480 square miles of the Missouri River Basin flow into Lewis & Clark Lake. Fort Randall Dam, 39 miles upriver from the lake, controls all but 16,000 square miles of this drainage. Most of Lewis & Clark Lake's uncontrolled drainage comes from the Niobrara River which enters the Lake at RM 844.0. The Niobrara transports a heavy sediment load into the reach. It is estimated the Niobrara contributes 60% of the annual sediment inflow to the Lake, making it the major contributor to the accumulation of sandbars and formation of the delta in the upper third of the Lake.

Lewis & Clark Lake is managed between 1208.0 feet msl (maximum) and 1204.5 feet msl (minimum) operating pool levels. Under flood conditions the lake can be raised an additional two feet to 1210.0 feet msl. The reach's topography is divided into two distinct types. Missouri River breaks that rise to 100 feet above the lake confine the eastern half of the lake. The western half is a relatively flat floodplain headwater area of braided channels and islands that become rolling prairie hills away from the lake.

The reach is located in an area typical of a continental-interior climate with variations in weather not only from season to season but also from year to year. Hot summers and cold winters are typical with humidity ranging from an average of 60% in the afternoon to 80% during the night and early dawn. The frost-free period in the area averages 155 days. Precipitation in the region averages 25 inches of rainfall annually with the majority of it occurring during the spring and summer months. Thunderstorms can be expected to occur about 45 days out of the year. Activities on the lake include wildlife management and recreation. Visitation to the lake topped 2.5 million visitors in 1994.

Temperatures can exceed 100 degrees Fahrenheit during the nesting season with an average summer daily temperature of 72 degrees. Winds in the area of the lake are predominantly from the south-southwest during the summer and from the northwest during the winter months. It is not uncommon to have winds up to 50 mph during the year. The highest average wind speed for a one-month period occurs during April, with a daily average of 14 mph.

Piping plovers begin arriving and nesting at Lewis & Clark Lake during the last week in May and the first week in June. The least terns arrive and begin nesting during the first two weeks of June. Habitat in the reach is limited to islands located in the deposition zone at the headwaters of the lake. These sites, with very little relief, are susceptible to flooding with even slight increases in lake elevation or tributary contribution. The thirteen year average for the annual adult census on the lake is 24 plovers and 47 terns.

Gavins Point River Reach: The Gavins Point Reach of the Missouri River begins at the Gavins Point Dam and travels in a southeasterly direction 58 miles to Ponca NE (RM 753.0). The river here forms the boundary between South Dakota on the north and Nebraska on the south. The majority of the water in this reach is released from Gavins Point Dam. The two primary tributaries on the reach are the James River, which joins the Missouri at RM 800.5 and the Vermillion River, which enters the Missouri at RM 772.0.

As the last control structure on the Missouri River, Gavins Point Dam serves to provide stabilized downstream releases, maintaining municipal water supplies and the navigation channel below Sioux City IA. Controlled releases from Gavins Point Dam, to maintain navigation, have eliminated periodic flooding from most of the reach. Flooding from the James and Vermillion Rivers however can effect the reach. These tributaries and their sediment loads have maintained a pseudo cycle of habitat aggradation and degradation, critical to maintaining least tern and piping plover habitat.

The topography of the Gavins Point reach is that of a broad flat floodplain on the South Dakota side and a floodplain interspersed with steep, tree covered bluffs on the Nebraska side. Primary use of the floodplain includes farming and livestock grazing. Mature cottonwood trees are found only in a narrow broken corridor next to the river as a result of clearing and agricultural development on the rest of the floodplain. As a result of stabilized river flows, sandbars quickly vegetate with annual weeds and grasses, sedges, and woody species.

The reach is located in an area typical of a continental-interior climate with great variations in weather not only from season to season but also from year to year. Hot summers and cold winters are typical with humidity ranging from an average of 60% in the afternoon to 80% during the night and early dawn. The frost-free period in the area averages 155 days. Precipitation in the region averages 25 inches of rainfall annually with the majority of it occurring during the spring and summer months. Thunderstorms can be expected to occur about 45 days out of the year. Tornado and severe weather pass through the region infrequently. Temperatures can exceed 100 degrees Fahrenheit in the summer with average summer daily temperature of 72 degrees. The winds are predominantly from the south-southwest during the summer and it is not uncommon to have winds up to 50 mph during the year.

Potential piping plover and least tern conflicts include recreation, agriculture, bank stabilization projects, water intakes for cities, and housing developments. Recreational use of the river includes fishing, both from shore and boats, pleasure boating, jet skis, canoeing, swimming and sunbathing. In 1980 Congress designated this stretch of the Missouri as a National Recreation River.

Piping plovers begin arriving below Gavins Point Dam as early as the last week in April. Most nest initiations begin in May and continue into early June. Least terns begin arriving below Gavins Point Dam during the last week in May. The majority of tern nests are initiated during the first two weeks in June. This portion of the Missouri has historically been the most important nesting area for both species on the Missouri River. The thirteen year average for the annual adult census has been 111 plovers and 180 for terns.

1998 SURVEY AND MONITORING ACTIVITIES

HABITAT CONDITIONS & BIRD ARRIVALS

Surveys to locate active nesting colonies for monitoring purposes were conducted from May to July. These surveys were conducted with the aid of binoculars or spotting scope. Potential nesting areas were typically observed from a boat. Large islands or beach areas accessible from land were searched on foot using bird behavior to indicate nesting colonies. Sites found to have terns or plovers exhibiting nesting or courting behavior were recorded on U.S. Army Corps of Engineers aerial mosaic maps (Appendix D) and monitored during production surveys.

Overall, habitat conditions on the system were very good to excellent for least terns and piping plovers in 1998. After three consecutive years of high runoff culminating with a record runoff of 49.1 million acre feet of water past Sioux City, Iowa in 1997, the Missouri River returned to "normal" in 1998. Runoff past Sioux City is expected to be 26.8 million acre feet for 1998. This is 109% of the normal annual runoff of 24.6 million acre feet. Three years of high releases from Garrison, Fort Randall and Gavins Point Dams scoured islands of vegetation and pushed up sandbars on the Missouri below each of these dams. The result has been the largest amount of riverine habitat available for the species since both were listed in 1986. The return to normal runoff also resulted in normal lake levels for Fort Peck Lake, Lake Sakakawea, and Lake Oahe. In 1997, all three lakes rose into their exclusive flood zones, virtually eliminating all shoreline habitat. For 1998, abundant island and shoreline beach habitat was available to the plovers and terns at all three lakes. A reach by reach description of habitat conditions during the arrival of the plovers and terns is discussed below.

Fort Peck Lake: Nesting habitat was good to excellent on most beach sites at Fort Peck Lake. At the beginning of May the lake elevation stood at 2236.20 feet msl. This was about four feet lower than one year previous. As a result the quality and quantity of gravel/shale habitat was higher than noted during the previous two years. Throughout the nesting season habitat remained good as the lake rose just four feet, peaking at 2240.46 feet msl on July 25. This was very close to the median runoff target level of 2240.7 feet msl.

Surveys for plovers and terns began on Fort Peck Lake on May 6. The earliest piping plover sighting occurred on May 12 at Beach 5. The plovers had arrived at this site before that date as a nest was initiated on May 2. The last plover nest initiation on the lake occurred on June 1. The earliest least tern sighting, also on Beach 5, occurred on June 4

when two birds were observed. The earliest tern nest initiation was June 2 with the last being on June 5.

Fort Peck River: In May habitat on the Missouri River below Fort Peck Dam was in excellent condition. Habitat remained plentiful throughout the nesting season. Average releases out of Fort Peck Dam were as follows, May - 9,700 cubic feet per second (cfs), June - 10,100 cfs, July - 9,200 cfs and August - 9,700 cfs. These releases were close to or below the target median releases forecast for Fort Peck Dam.

On the west subsample (RM 1714.0 - 1673.0), surveys began on May 4. One piping plover was observed during this initial survey. The only plover nest found within the subsample was initiated on June 20. The first least tern observation on the subsample was June 4, but a nest was determined to have been initiated on May 29. The last tern nest was initiated on June 23.

On the east subsample (RM 1581.0 - 1568.0) surveys began during the week of May 11. Piping plovers were not observed on the subsample until June 22 when a nest was found. The earliest plover nest initiation was June 19 with the latest being June 25. Least terns were first observed on May 24. All three tern nests found on the subsample were initiated on June 24.

Lake Sakakawea: Habitat conditions on Lake Sakakawea improved dramatically in 1998 compared to 1997. In 1997 the lake was at 1847.5 feet msl at the start of the nesting season and peaked at 1854.37 feet msl on July 1, the second highest lake level ever recorded. This high lake level eliminated virtually all of the nesting habitat on Lake Sakakawea. On May 1, 1998 the lake elevation was at 1839.30 feet msl, eight feet below the 1997 level. The lake would eventually peak at 1843.45 feet msl on July 27, almost eleven feet below 1997's level. The high lake level in 1997 and the return to a normal level in 1998 created miles of shoreline and island beach habitat for the terns and plovers.

The first survey for least terns and piping plovers on Lake Sakakawea was conducted the week of May 3. One piping plover was observed near the Steinke Bay Habitat Area. There was a wide range in plover nest initiations on Lake Sakakawea in 1998. The earliest initiation occurred on May 4 with the last occurring on July 2. Least terns were first seen on Lake Sakakawea on June 17 near Tobacco Garden Bay. The terns had been there for at least two weeks as the earliest nest initiation for a tern on the lake was June 4 at Tobacco Garden Bay. The latest nest initiation on the lake was July 16.

Garrison River: At the beginning of the nesting season, habitat conditions on the Missouri River below Garrison Dam were excellent and remained that way through the nesting season. Average releases out of Garrison Dam during the nesting season were as follows: May – 24,200 cfs, June – 25,700 cfs, July – 24,000 cfs and August – 24,000 cfs. These releases were close to or below the forecasted median releases for Garrison Dam.

Monitoring on the Missouri River below Garrison Dam began the week of May 3 however, no plovers were observed. The first two plovers on the reach were observed at RM 1380.5 during the week of May 17. The first plover nest was initiated on the reach on May 18, the last on July 3. Terns were first seen on this portion of the Missouri River on June 8 at RM 1349.7. The terns had arrived earlier as the first tern nest initiation occurred on May 28 at RM 1324.5. The last nest initiation for a tern on the Garrison Reach occurred on June 30 at RM 1349.7.

Lake Oahe: As with Fort Peck Lake and Lake Sakakawea, Lake Oahe returned to near normal conditions in 1998. The lake was at elevation 1609.7 feet msl on May 1 and peaked at 1612.68 feet msl on July 22. This is about six feet below the 1997 peak of 1618.56 feet msl. The lower lake level resulted in a substantial improvement in both the quantity and quality of the habitat.

Surveys on Lake Oahe began on the week of May 11. Piping plovers were observed on the lower lake during this initial survey at Little Bend, Mission Island, and Agency Creek. At the time of this survey, plovers had already been at Little Bend for three weeks as a nest was initiated there on April 20. This was the earliest nest initiation ever for Lake Oahe and was also the earliest nest initiation for any plover nest on the Missouri River System since surveys began in 1986. The last plover nest initiation on Lake Oahe occurred on June 30. Least terns were first observed on the lower part of the lake at Mission Island during the last week in May. The earliest tern nest initiation was also at Mission Island, occurring on May 25. The last tern nest initiation occurred on July 6 on the Cheyenne River Arm.

Fort Randall River: In sharp contrast to previous years, plentiful habitat was available to the terns and plovers on the Missouri River below Fort Randall Dam. The average releases from Fort Randall Dam during the nesting season were as follows, May – 24,200 cfs, June – 22,200 cfs, July – 24,800 cfs, and August – 26,400 cfs. These releases were significantly below the forecasted median releases for Fort Randall Dam.

Surveys on the Fort Randall River Reach began on April 29. No plovers were observed during this initial survey. Plovers were first seen on the reach on May 18 on sandbars at RM 851.5. The plovers first nest initiation on the Reach was May 6. The last plover nest initiation occurred on June 21. Least terns were first observed on May 20 on a sandbar at RM 869.0. The earliest tern nest initiation was on June 6 with the last nest initiation occurring on July 1.

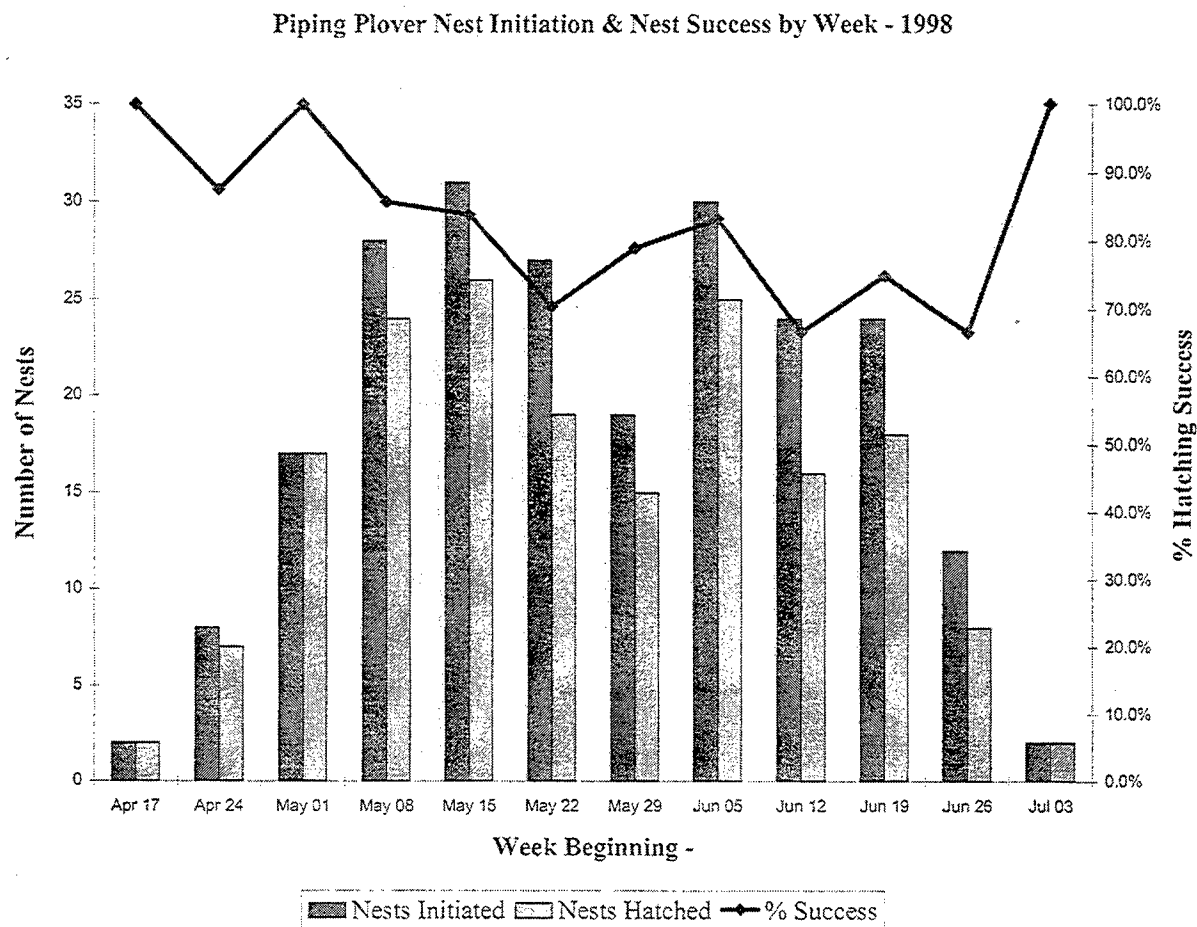
Lewis & Clark Lake: Habitat on Lewis & Clark Lake was very good to excellent throughout the 1998 nesting season. Areas in the upper lake that had been inundated in 1997 due to high releases from Fort Randall Dam re-emerged in 1998 and were available for the birds. Less than normal releases from Fort Randall Dam allowed for a fairly stable lake elevation on Lewis & Clark that varied from a low of 1205.6 feet msl to a high of 1207.3 feet msl during the summer.

As in 1997, surveys of the Lewis & Clark Lake Reach included the mouth of the Niobrara River. The first survey of the 1998 nesting season occurred here on April 27 and sixteen piping plovers were seen. The first survey on Lewis & Clark Lake proper was done on May 21 and three plovers were observed. The earliest nest initiation for plovers on the lake was May 4 at RM 842.3. The last plover nest initiation was at RM 832.2 on July 4. The first sighting of least terns on the reach was at the mouth of the Niobrara River when two terns were seen on May 20. Terns were not observed on Lewis & Clark Lake until June 5, but the earliest nest initiation was on May 26 at the sandbar complex at RM 842.3. This complex was also the site of the last nest initiation, July 12.

Gavins Point River: Following three years of high releases out of Gavins Point Dam a return to near normal releases in 1998 provided abundant habitat on the Missouri River below the dam. The average releases from Gavins Point Dam during the nesting season were as follows, May – 29,100 cfs, June – 28,000 cfs, July – 29,600 cfs, and August – 30,700 cfs. These releases were all below the forecasted median releases for Gavins Point Dam.

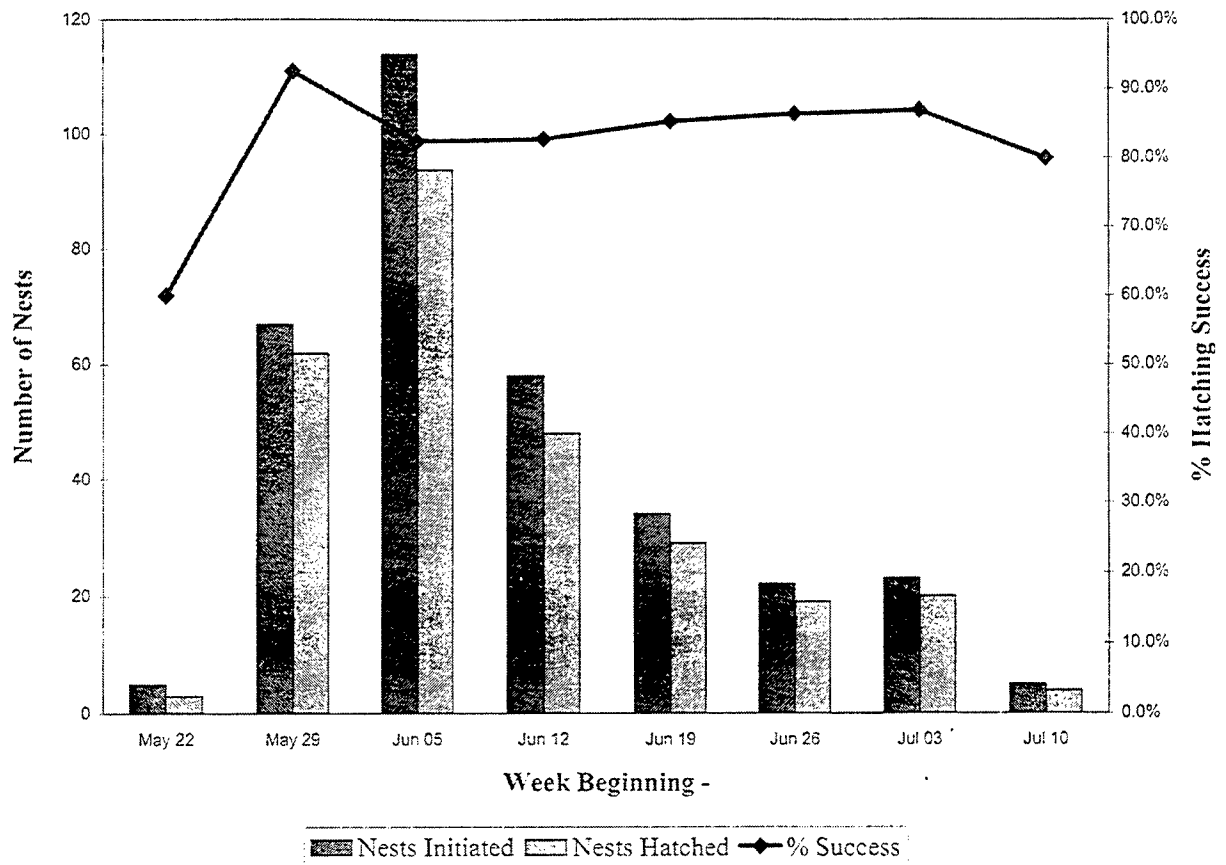
Surveys on the Missouri River below Gavins Point Dam began on April 28, with five plovers observed at RM 804.5. The earliest plover nest initiation on the reach occurred on April 29 at RM 804.5. The last plover nest initiation occurred at RM 756.5 on June 25. Terns were first sighted on the Gavins Point Reach on May 24 at several sites on the river. The earliest tern nest initiation was also on May 24, at RM 789.0. The last tern nest initiation occurred on July 14 at RM 756.5.

The chart below shows piping plover nest initiation and success by week for 1998. Compared to previous years two points are conspicuous. There was a pronounced shift to earlier nest initiations with a greater than normal number of nests being initiated in late April and early to mid May. The other item was a much higher nest hatching success compared to previous years. This will be more fully discussed in the productivity section.



Unlike piping plovers there was no tendency for early nest initiations by least terns in 1998. As illustrated on the next page and conforming with previous years, the week of June 5 saw the highest number of systemwide least tern nest initiations for the 1998 nesting season. However like the plovers, the terns saw a much higher nest hatching success in 1998 compared to previous years. This phenomenon will be discussed in the productivity section.

Least Tern Nest Initiation & nest Success by Week - 1998



ADULT CENSUS

The adult census for least terns and piping plovers along the Missouri River was conducted during the last week in June and first week of July 1998. The census was conducted by boat or vehicle using binoculars or spotting scopes to aid in observation. Adults were counted while incubating clutches, loafing on beaches and sandbars, or flying overhead near the nesting sites. If heavy vegetation existed on an area, the site was entered, causing the birds to flush where they could be counted in the air. On sites with large nesting colonies, where actual counts were improbable, the census was recorded as twice the number of active nests plus the brooding pairs. Date, time, observers, weather, and site location were recorded on each census record (See Appendix A). All terns and plovers observed on the Missouri River having adult plumage were recorded as breeding adults.

The dates when the adult census was conducted, by reach, are listed below.

Fort Peck Lake	June 23 & 25
Fort Peck River	June 22, 29 & 30
Lake Sakakawea	June 22-26, 29-30, July 1
Garrison River	June 22-24, July 1, 3
Lake Oahe	June 22-25, 30, July 1, 2, & 4

Fort Randall River

June 24

Lewis and Clark Lake

June 29-30, July 2

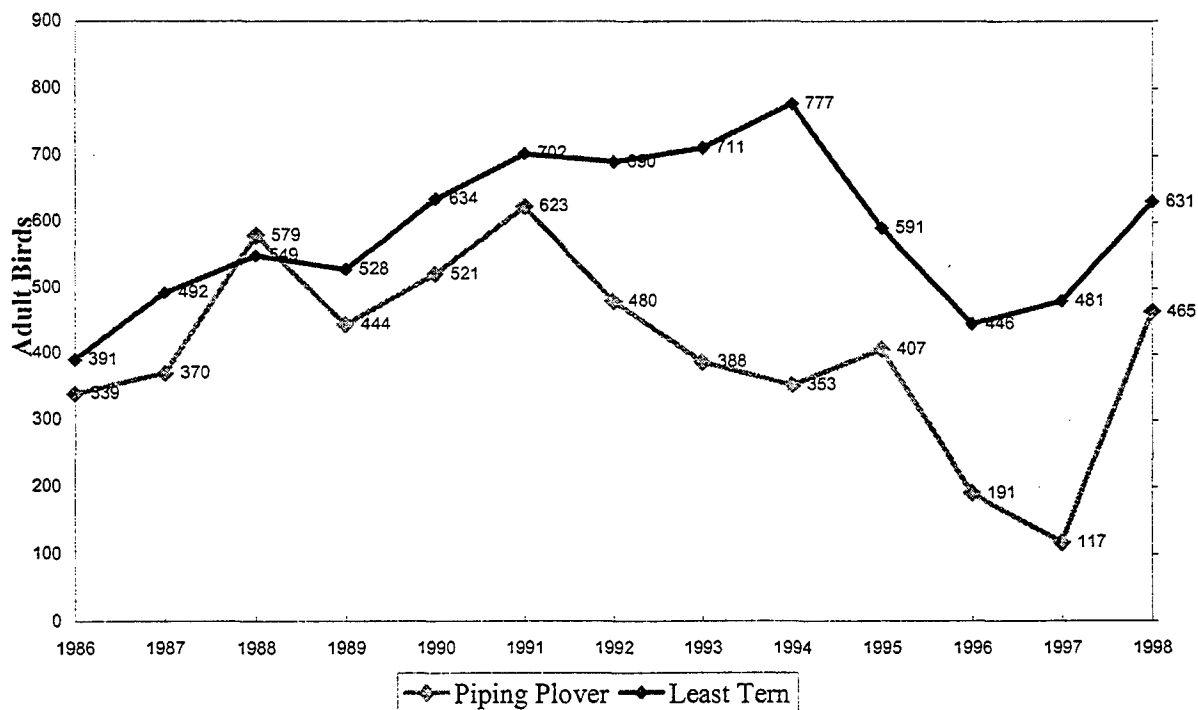
Gavins Point River

June 22, 24-26

The 1998 adult census for the Missouri River showed a rebound in adult numbers for piping plovers with 465 being found on the System. This represents a 297% increase (465/117) in plover numbers compared to 1997. This increase was due to abundant habitat and normal flows following three years of near record flows that reduced plover numbers to an all time low of 117 in 1997. This increase reverses a trend that has seen piping plover adult numbers decline on the System during five of the previous six years. Still, the 1998 plover adult census is 25% lower (465/623) than the peak year of 1991.

Least tern adult numbers also increased in 1998 on the System but not nearly as dramatically as the piping plover. The 1998 adult census recorded 631 adult terns on the system. This represents a 31% (631/481) increase compared to 1997. Still, tern numbers were down 19% (631/777) compared to the peak year of 1994. The graph below depicts thirteen years of adult censuses on the Missouri River system. The years 1986 and 1987 represent incomplete censuses. Censuses were not done for the Fort Peck River and Lake Sakakawea reaches during those years.

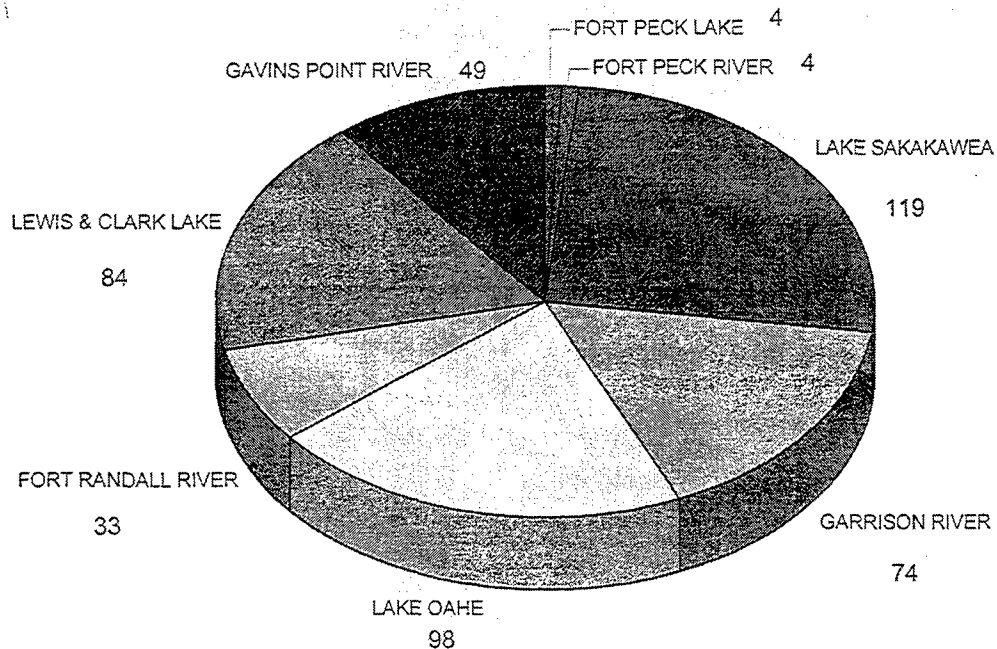
Least Tern & Piping Plover Adult Census 1986 - 1998



Compared to 1997, piping plover adult numbers increased on seven of the eight reaches. Fort Peck Lake saw an increase in adult numbers, but the increase was minimal going from zero plovers in 1997 to four in 1998. The Fort Peck River Reach was the only reach to see a decrease in numbers going from 23 adults in 1997 to 4 in 1998. This decrease may have been the result of the plovers finding better habitat lower on the System. Lake Sakakawea recorded the highest number of plovers on the System and saw the greatest increase compared to 1997, (119/3). This was due to the availability of habitat. In 1997, the lake reached elevation 1854.0 feet mean sea level (msl), virtually eliminating all habitat. In 1998, the lake peaked at elevation 1843.0 feet msl. This eleven foot difference allowed for extensive shoreline and island beach habitat to remain exposed. Just below Lake Sakakawea the Garrison River Reach saw a substantial increase in plovers going from 6 in 1997 to 74 in 1998. Lake Oahe tripled its plover numbers going from 31 in 1997 to 98 in 1998. While no adult plovers were seen below Fort Randall Dam in 1997, 33 were recorded on the reach in 1998. This was the highest number ever observed on the Fort Randall Reach. Lewis & Clark Lake had a two and half times increase in plover numbers going from 32 in 1997 to 84 in 1998. This is the highest number of plovers ever found on the Lewis & Clark Lake Reach. The plover census below Gavins Point Dam doubled, going from 22 to 49. Though substantial compared to 1997, this increase was disappointing compared to the late 1980s and early 1990s when plovers averaged 167 adult birds on the reach. The lack of higher numbers cannot be blamed on habitat, which was plentiful and in the best condition since the piping plover was listed as threatened in 1985. Numbers are expected to increase on the Gavins Point Reach as habitat conditions stabilize and birds relocate back to the river.

The pie chart on the next page shows the distribution of adult plovers by reach on the System.

PIPING PLOVER ADULT CENSUS BY REACH - 1998

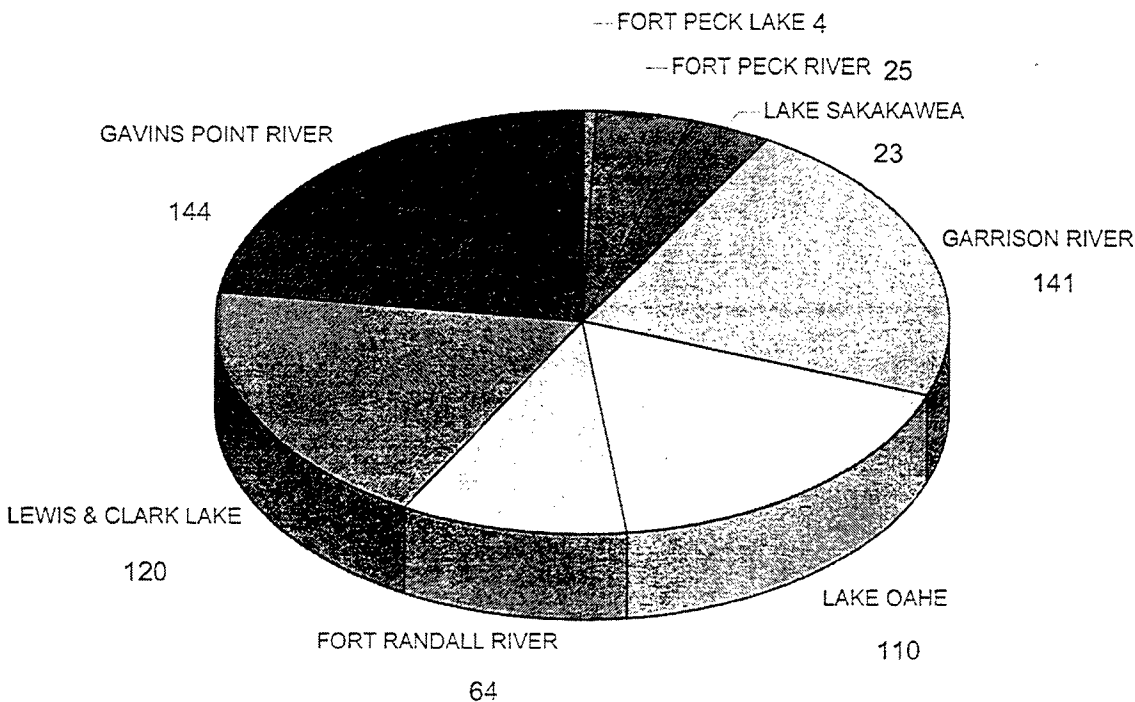


Seven of the eight reaches saw an increase in adult least tern numbers in 1998 compared to 1997. Fort Peck Lake had a minimal increase going from zero terns to four. Lake Sakakawea had a substantial increase for an area that has traditionally been marginal for least terns, going from 2 to 23. Tern numbers below Garrison Dam tripled, going from 41 in 1997 to 141 in 1998. Lake Oahe had a slight increase with 110 adult terns compared to 101 in 1997. The Fort Randall River Reach had a large increase in terns, going from none in 1997 to 64 in 1998. The 1998 adult census represented the largest number of terns ever found on the Fort Randall River Reach since censuses were first conducted in 1986. The Lewis & Clark Lake Reach adult tern census numbers doubled from 60 in 1997 to 120 in 1998. As with the plovers on Lewis & Clark Lake, this was the highest number of terns found on the reach since censuses began in 1986. The Gavins Point River Reach had the highest number of adult terns of the eight reaches. The 144 terns represented a 25% increase compared to the 115 terns counted on the reach in 1997. This is still well below the average of 211 terns seen on the reach from 1986 to 1994.

The Fort Peck River Reach saw a dramatic decline in least tern numbers. Only 25 terns were seen in 1998 compared to 162 in 1997. The availability of good habitat to the south of the reach may be the reason behind the decline. In 1997 the amount of habitat below the reach was drastically reduced due to high releases from Garrison, Fort Randall, and Gavins Point Dams. With normal releases in 1998, habitat below these dams was abundant.

The pie chart below shows the distribution of adult terns by reach on the System.

LEAST TERN ADULT CENSUS BY REACH - 1998



PRODUCTIVITY AND RECRUITMENT OF FLIGHTED CHICKS

Productivity monitoring provides a standard of measurement with which success or failure of implemented management practices can be evaluated. Recovery efforts must be evaluated against the return gained from annual reproductive efforts or in the recruitment of young to the adult population. Considering this, fledge ratio goals (number of juveniles produced annually per pair of breeding adults) were established by the Biological Opinion.

This provides a target while implementing management activities on the Missouri River. Correct estimates of these ratios are essential to evaluate the success of efforts applied towards meeting recovery goals. Every effort was made to accurately collect and report all aspects of the productivity monitoring activities during 1998.

All areas containing active nesting sites, identified through earlier habitat use surveys, were revisited every seven to ten days during the summer to record nesting activity and chick survival. (The exception was the Fort Peck River Reach where productivity was geographically subsampled.) Active nesting sites were searched to determine the number of nests and principle causative factors responsible for nest termination once it occurred. Each site was searched on foot and with the aid of binoculars. Nests were located by observing adult behavior or by doing systematic searches of the colony site. Each nest was identified by placing a numbered wooden tongue depressor within one meter of the nest. Nests were relocated every seven to ten days until the nest was terminated. All nest site activity was limited to twenty minutes or less including any passive predator management activities.

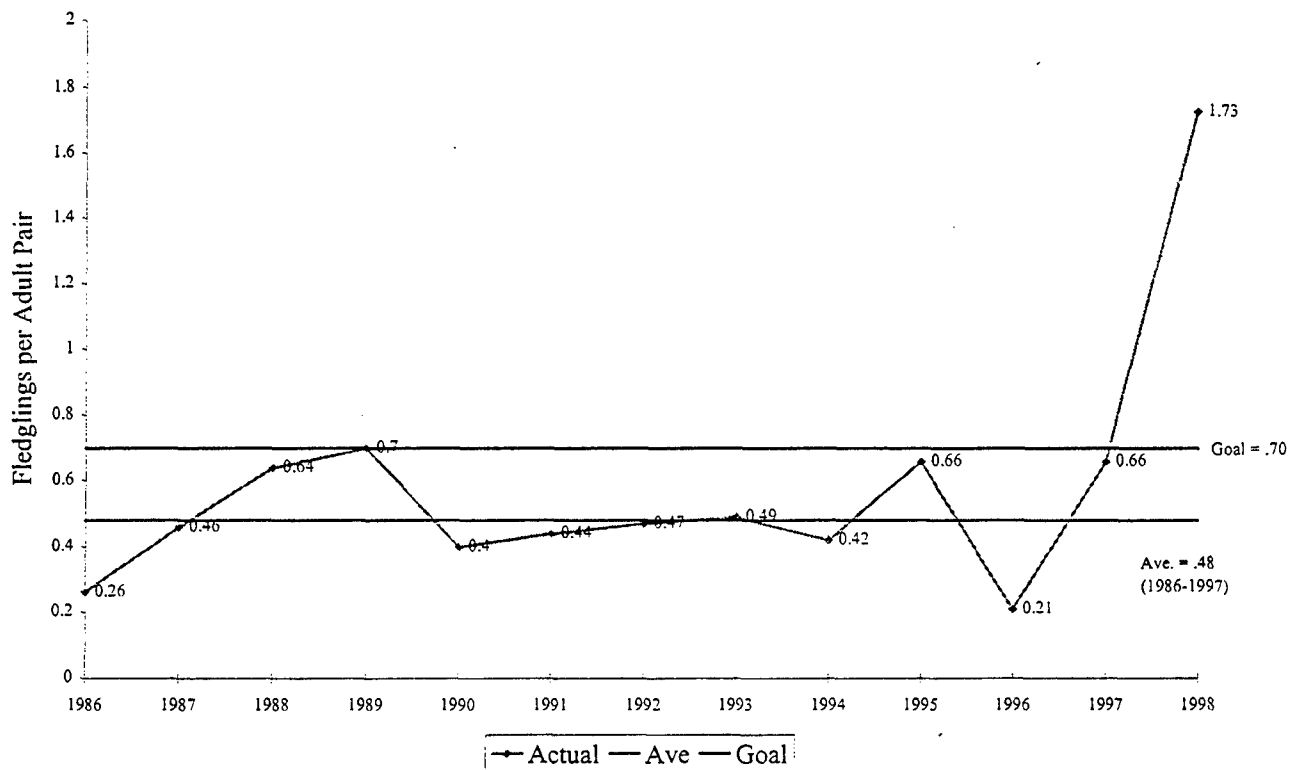
The updated (1997) standardized data card, on which nest information is recorded, was used for the 1998 nesting season. Data entry on the card includes species, number of eggs, stage of incubation, nest location, nest initiation date, nest fate, site map, and any comments (See Appendix A). Stage of incubation was obtained using the egg flotation method. Only eggs from nests with complete clutches were floated. Cause of nest termination was recorded as hatched, destroyed, abandoned, non-viable, or fate unknown. Hatched nests were determined by the presence of chicks, egg shells, pipping fragments or chick excrement in the nest bowl. A nest was considered successful if a single egg hatched. Attempts were made to identify destroyed nests to a principle causative factor. These included but were not limited to flooding, weather, human disturbance, livestock disturbance, predation, and abandonment. If a cause could not be determined the nest was listed as destroyed unknown. If it could not be determined if a nest had hatched, the nest was listed as fate unknown.

Chick survival was recorded simultaneously during weekly nest searches of nesting areas. As the breeding season progressed, efforts were concentrated on locating chicks and keeping track of fledged chicks using natal areas. Chicks were typically flushed ahead of observers on the nesting sites and aged by visual observation of body size and primary feather development. Care was taken to prevent chicks from fleeing into the water during observation activities. Chick records were maintained during the fledging period by recording each observation on the chick record portion of the adult census card. Because of

a high probability of fledging before the next week's visit, twenty-two day old plovers and fifteen day old least terns were considered fledged.

Productivity throughout the Missouri River System was unprecedented in 1998 for least terns. The fledge ratio systemwide was an extraordinary 1.73 fledglings per adult pair. This is nearly two and half times the Biological Opinion goal of 0.70 fledglings per adult pair and three and half times better than the twelve average of 0.48 fledglings per adult pair. The previous best year was 1989 when the fledge ratio was 0.70. The graph below shows the 1998 annual least tern fledge ratio compared to the preceding twelve years of productivity monitoring.

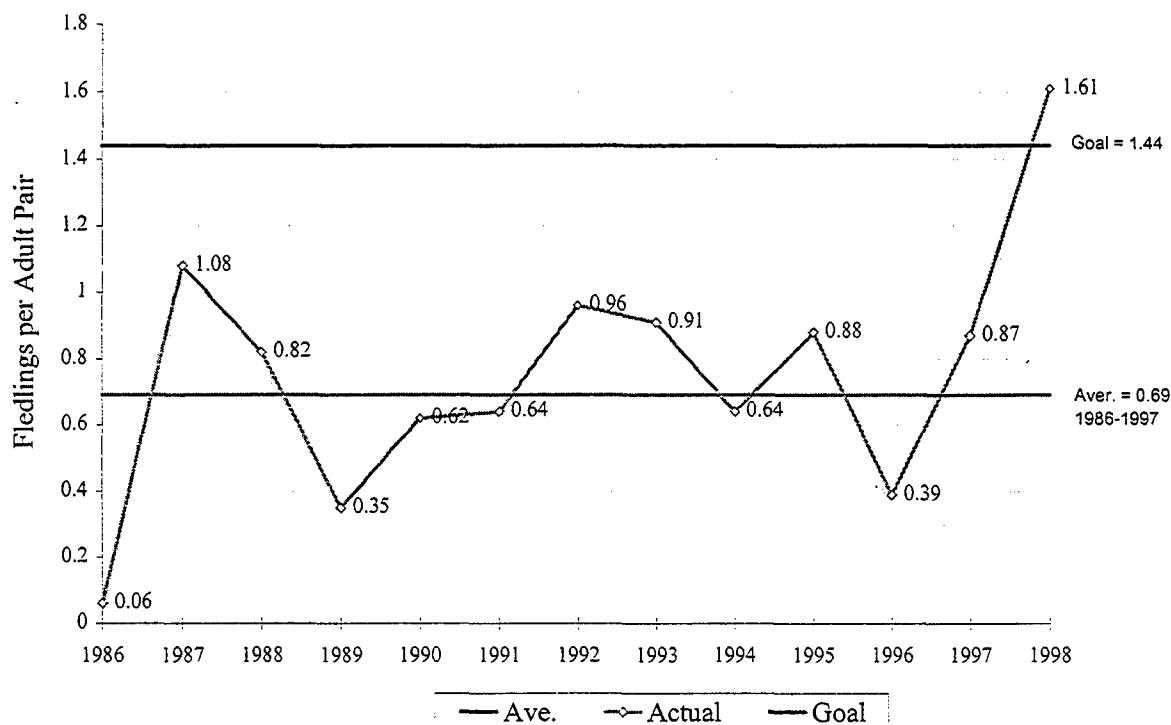
Least Tern Fledge Ratio 1986-1998



Piping plover productivity on the Missouri in 1998 saw the same unparalleled increase as the least terns. The fledge ratio systemwide was 1.61 fledglings per adult pair. This marked the first time in thirteen years of productivity monitoring that the Biological Opinion goal of 1.44 fledglings per adult pair had been exceeded. The average fledge ratio for the previous twelve years is 0.69 with the best year being 1987 when the fledge ratio

was 1.08. The graph below shows the 1998 annual piping plover fledge ratio compared to the preceding twelve years of productivity monitoring.

Piping Plover Fledge Ratios 1986-1998



The remarkable productivity for both species was due to a combination of factors. Foremost of these was the three years of above normal runoff culminating with 1997's record runoff of 49.7 million acre feet. On the reservoirs, the retention of this record runoff raised the lake levels and inundated vegetated shorelines. The return to normal runoff exposed this newly formed beach habitat, devoid of vegetation. The need to evacuate reservoir storage in turn resulted in elevated releases from the dams. The elevated releases created new sandbars, built up existing sandbars, and created new habitat by scouring vegetation off of sandbars and islands. Again the return of normal runoff in 1998 led to normal releases exposing this new habitat. The net result was the best habitat, both qualitative and quantitative, on the Missouri River System since the two species were listed in 1986.

Extensive habitat throughout the System in 1998 proved beneficial to the terns and plovers. An obvious benefit was that the abundance of habitat allowed the birds to pick and choose optimum sites for nesting and rearing young. This habitat distribution also made it

much more difficult for predators to find nests and young. Also there were no devastating storms during the nesting season and localized flooding was held in check by manipulations in the releases from the dams. The net result was outstanding nest success for both species in 1998. Least tern observed nest success System-wide was 82.5% (282/342). Piping plover observed nest success was 77.2% (179/232). This compares to an average System (1986-1997) observed nest success of 41.7% for least terns and 40.9% for piping plovers. Nest success was followed by the aforementioned remarkable fledge ratios for the birds. As good as these fledge ratios were, they may have been understated. The vast amounts of habitat at times made it difficult to find new fledged birds and this was compounded by the inexperience of some crews doing the monitoring.

Results of the 1998 production surveys are given for terns (Table Page 30) and for plovers (Table Page 30). See Appendix B for a site by site synopsis of the mainstem system. A reach by reach summary of productivity follows the tables.



"The Complex"

This sandbar complex located at RM 842.0 just to the east of Niobrara Nebraska was the home of 46 adult plovers, 23 plover nests, 57 fledged plover chicks; 52 adult terns, 33 tern nests, and 67 fledged tern chicks in 1998.

MAINSTEM MISSOURI RIVER PIPING PLOVER PRODUCTIVITY MONITORING, 1998.

REACH	NESTS	NEST HAT	NEST COLL	NEST SUCC.	EGGS HAT	EGGS COLL	FLOOD	FATE DESTROYED PRED.	FATE DESTROYED H. DIST.	BANK E.	WTHR.	LIVESTOCK	DEST. UNKN.	FATE UNKN.	ABAN.	NON VIABLE	ADULT CENSUS	CHICKS FLEDGE	COLL. CH. RELEASED
FTPKRES	2	1	0	50.0	8	4	0	0	0	0	1	0	0	0	0	0	4	0	0
FTPKRIV	3	2	0	66.7	9	7	0	0	0	0	0	0	1	0	0	0	4	2	0
LKSKRES	64	46	0	71.9	203	137	0	0	1	0	1	0	5	2	1	0	119	74	0
GARRRIV	32	27	0	84.4	119	93	0	0	0	0	2	0	1	1	0	1	74	68	0
LKOHRES	41	33	0	80.5	139	110	0	0	0	0	1	1	2	2	1	1	98	51	0
FTRLRIV	14	11	2	78.6	56	43	8	0	0	0	0	0	0	0	0	0	33	21	8
LECLRES	49	40	3	81.6	173	134	11	0	1	0	0	0	2	1	2	0	84	103	11
GAPTRIV	28	20	1	71.4	100	70	4	0	1	0	0	0	3	1	1	1	49	54	2
TOTAL	233	180	6	77.3	807	598	23	9	1	2	0	5	1	14	7	5	465	373	21

MAINSTEM MISSOURI RIVER LEAST TERN PRODUCTIVITY MONITORING, 1998.

REACH	NESTS	NEST HAT	NEST COLL	NEST SUCC.	EGGS HAT	EGGS COLL	FLOOD	FATE DESTROYED PRED.	FATE DESTROYED H. DIST.	BANK E.	WTHR.	LIVESTOCK	DEST. UNKN.	FATE UNKN.	ABAN.	NON VIABLE	ADULT CENSUS	CHICKS FLEDGE	COLL. CH. RELEASED
FTPKRES	2	1	0	50.0	6	3	0	0	0	0	1	0	0	0	0	0	4	0	0
FTPKRIV	11	8	0	72.7	28	20	0	0	1	0	0	0	0	2	0	0	25	19	0
LKSKRES	20	15	0	75.0	50	32	0	0	0	0	2	0	0	3	0	0	23	12	0
GARRRIV	73	57	0	76.1	161	140	0	0	0	0	3	0	0	11	2	0	141	107	0
LKOHRES	48	40	0	83.3	126	102	0	0	1	0	0	0	0	4	1	1	110	71	0
FTRLRIV	33	31	0	93.9	83	76	0	0	0	0	0	0	0	1	1	0	64	30	0
LECLRES	72	60	0	83.3	176	145	0	0	0	0	0	0	0	7	5	0	120	140	0
GAPTRIV	63	70	0	84.3	214	178	0	0	0	0	0	0	0	8	5	0	144	168	0
TOTAL	342	262	0	82.5	864	698	0	0	1	1	0	6	0	36	14	1	631	547	0

Fort Peck Lake: For the first time since 1995 piping plovers and least terns nested on Fort Peck Lake. Despite a large increase in habitat there were just two plover nests and two tern nests on the lake in 1998. The plover nests were found on separate beaches while the two tern nests were on the same beach. One plover nest and one tern nest hatched and chicks were observed on several occasions. Before the other two nests hatched a storm hit the Fort Peck area on June 26. Both nests were lost to wind generated waves. Dead tern chicks were found on the beach in the aftermath of the storm. The plover chicks were never relocated after the storm and were assumed lost. In fact, following the storm, no plovers or terns were seen on the lake for the rest of the summer.

Fort Peck River: The two subsamples monitored in 1998 each contained one site where plovers nested. There were only three nests at these two sites with two nests hatching. The one that did not hatch was destroyed by unknown causes. There were two plovers that fledged on the reach for a fledge ratio of 1.00. There were no plovers seen outside the subsamples during the adult census so the total number of fledged plovers for the entire reach was not adjusted.

There were five tern nesting sites in 1998, four on the west subsample and one on the east. Together the five sites produced eleven nests, eight of which hatched. Of the three nests where hatching could not be confirmed, one was lost to predation and two were fate unknown. Twenty eggs were known to have hatched and sixteen chicks fledged resulting in a fledge ratio was 1.52. Applying this fledge ratio to the non-monitored portion of the reach, the reach gained an additional three fledglings bringing the 1998 total to nineteen fledged terns.

Lake Sakakawea: Piping plovers were widely distributed across Lake Sakakawea with nests being found at twenty-two sites around the lake. This compares to just nine nesting sites on the lake in 1997. Five of the 1998 sites, Beacon Island, Lake Jessie, Lutheran Bible Camp, Nishu Bay, and West Totten, represent sites that previously had never recorded plover nests. There were 64 nests on the lake compared to just 13 nests in 1997. Observed nest success was nearly 72% with 46 of the 64 nests hatching. Of the eighteen nests that did not hatch eight were lost to flooding, five were destroyed by undetermined causes, two were fate unknown, one was lost to weather, one was destroyed by human disturbance, and one nest was abandoned. 137 plover eggs hatched and of these 74 chicks were known to have fledged. The fledge ratio was 1.24 fledglings per adult pair. Plover production on the lake

was probably understated. Due to the immense expanse of habitat and subsequent lack of timely surveys the fate of several broods on the lake was unknown.

In contrast to piping plovers, least terns have never nested in large numbers on Lake Sakakawea. Though tern numbers rebounded over 1997 numbers, the lake again proved to be marginal for the species. Twenty nests were found at four locations on the Lake in 1998. The majority of the nests, 80% (16/20), were at one site, Lake Jessie, a new site located south of Williston ND at RM 1543.0. Fifteen of the twenty nests on the reach hatched with two lost to weather and fate of three were unknown. Twelve chicks were known to have fledged giving the Lake a fledge ratio of 1.04.

Garrison River: Compared to the washout of 1997 when only one plover nest was found on the Missouri River below Garrison Dam, there were 32 nests on 16 sites in 1998. Observed nest success was 84.4% with 27 of the 32 nests hatching. Of the five nests that did not hatch two were lost to weather events, one was destroyed by undetermined causes, one fate was unknown and one nest contained non-viable eggs. A total of 93 eggs were known to have hatched and 74 chicks fledged. The fledge ratio was 1.84.

Like the plovers the least terns bounced back from a poor 1997. The terns nested at sixteen sites on the river in 1998 compared to two in 1997. Nests were up 180% with 73 compared to 26 in 1997. Observed nest success for the terns was 78.1% (57/73). Of the nests for which hatching could not be confirmed three were lost to weather events, two were abandoned and the fate could not be determined for eleven. A total of 107 chicks fledged for a fledge ratio of 1.52. This was the highest fledge ratio ever on this reach.

Lake Oahe: The return to a stable lake elevation led to widespread nesting by the plovers on Lake Oahe in 1998. A total of twenty-three sites around the lake were utilized in 1998 compared to eight in 1997. Likewise nest numbers were up significantly with 41 in 1998 compared to 19 in 1997. Observed nest success on Lake Oahe was 80.5% (33/41). Of the nests that did not hatch, one was lost to weather, one to livestock, two were destroyed by undetermined causes, two were fate unknown, one was abandoned and one nest contained non-viable eggs. The plovers fledging success was very good with 52 chicks fledging compared to 20 in 1997. The fledge ratio of 1.06 for 1998 was below the 1.29 fledge ratio on the lake for 1997.

The least terns were also spread out over Lake Oahe, nesting at 27 sites compared to eleven in 1997 and three in 1996. The number of tern nests was down in 1998 compared to 1997. There were 48 nests in 1998 compared to 83 in 1997, a decline of 43%. Observed

nest success was nearly double the previous year with 83.3% of the nests (40/48) hatching in 1998 compared to 42.2% (35/83) in 1997. Of the nests that were lost one was destroyed by flooding, one by human disturbance, four had unknown fates, one was abandoned and one nest contained non-viable eggs. Unlike Fort Peck Lake and Lake Sakakawea, Lake Oahe has traditionally been home to large numbers of least terns during the nesting season. Unfortunately this has not translated into fledging success. The fledge ratios on the lake have been very poor for the last four years, 0.06 in 1994, 0.00 in 1995, 0.24 in 1996 and 0.16 in 1997. These poor results were reversed in 1998 with a fledge ratio of 1.29. A total of 65 tern chicks were known to have fledged on the lake in 1998. However small portions of the lake were not monitored throughout the nesting season. The Cheyenne River Sioux Tribe Game, Fish & Parks did conduct the adult census for these areas. Applying the 1.29 fledge ratio to the non-monitored portions of the lake, the reach gained an additional six fledglings bringing the 1998 total to 71 fledged terns.

Fort Randall River: After two years without nesting on the Missouri below Fort Randall Dam, the plovers returned in 1998. The plovers nested at five sites within the reach. This included two sites, a sandbar complex at RM 851.7 and a sandbar at RM 848.5, where the birds have not been previously recorded. There were fourteen plover nests on the reach in 1998, the most since 1991 and second most ever since monitoring began in 1986. Observed nest success was a very good 78.6% (11/14). One nest was lost to flooding and two nests were collected when it was feared they would be lost due to human disturbance. A total of 21 plovers fledged off the reach in 1998 for a fledge ratio of 1.27. This is a significant improvement for a reach that has historically been marginal for plover production. The 21 plovers and the 1.27 fledge ratio are the highest ever recorded and marks only the fourth time plovers have fledged off the reach in the thirteen years that monitoring has been conducted.

Following two years that saw just one nest initiated, the terns returned to the Fort Randall Reach. The terns nested at six sites on the river in 1998. This included the sandbar complex at RM 851.7 and the sandbar at RM 848.5 where, like the plovers, the birds had not been recorded previously. There were 33 tern nests on the reach in 1998, the most ever recorded in thirteen years of monitoring. The terns observed nest success was 93.9% with only two nests not hatching. Of these two, one was a fate unknown and the other was abandoned. Fledge success was very good. The thirty fledged chicks tripled the previous high of ten in 1991, and represented only the fourth time tern chicks had fledged off the reach. The fledge ratio of 0.94 was the highest since monitoring began in 1986.

Lewis & Clark Lake: Piping plovers nested at eleven sites on Lewis & Clark Lake Reach in 1998. This included ten sites on the Lake and one at the mouth of the Niobrara. In 1997 with the high flows, there were no nesting sites on the lake and the birds utilized only the mouth of the Niobrara. A total of 49 nests were found on the reach in 1998, the most ever for Lewis & Clark Lake. Of special note were a sandbar complex at RM 842.0 that contained 23 plover nests and an island at RM 838.0 with nine plover nests. Observed nest success was 81.6% with 40 of the 49 nests hatching. Of the nests that didn't hatch, one was lost to human disturbance, two were destroyed by undetermined causes, one fate was unknown and two were abandoned. In addition, three nests were collected to prevent their loss from flooding. Plovers fledged 103 chicks off the reach for a fledge ratio of 2.45. The 103 fledged chicks was the highest number of plovers that have ever fledged off the reach and the second highest for any reach. The 2.45 fledge ratio was the highest for any reach since monitoring began in 1986.

The terns nested at four sites on the Lake in 1998. Unlike 1997 where there were 34 tern nests at the mouth of the Niobrara, there was no nesting at this location in 1998. The terns were concentrated at three sites. There were 33 nests at the sandbar complex at RM 842.0 and 30 nests at the island at RM 838.0. Additionally there were eight nests on a small island at RM 832.2. Together these three sites accounted for all but one of the 72 tern nests found on the reach in 1998. Observed nest success for the terns was 83.3% (60/72). Of those that didn't hatch, five were abandoned and the fate of the other seven was unknown. Fledge success was unprecedented as 140 chicks fledged. This is the most ever for any reach since monitoring began in 1986. The fledge ratio was 2.33, again the highest for any reach since monitoring began.

Gavins Point River: Plovers were found at eighteen sites on the Missouri below Gavins Point Dam compared to just six sites in 1997. There were not a large number of nests with just twenty-eight compared to fourteen last year. Observed nest success was 71.4% (20/28). Of the nests that did not hatch, one was lost to predation, three were destroyed but the cause was undetermined, the fate of one was unknown, one was abandoned and one nest contained non-viable eggs. One nest was collected to avoid its possible loss to human disturbance. A total of 54 plover chicks fledged off the reach in 1998 for a fledge ratio of 2.20. This was the highest fledge ratio ever for the reach and very encouraging after two years of no production on the reach. The 54 juveniles represent the fourth highest annual production on the reach.

Least terns nested at fifteen sites on the Missouri below Gavins Point Dam in 1998. This was comparable to the thirteen sites the terns nested on in 1997, and the twelve sites in 1996. Nest numbers were down in 1998 compared to 1997 and 1996. There were 83 nests in 1998 compared to 106 in 1997 and 96 in 1996. Observed nest success for terns on Gavins Point was 84.3% (70/83). Of those that didn't hatch five were abandoned and for eight the fate was unknown. The high observed nest success was followed by an unprecedented fledge success. A total of 168 tern chicks fledged off the reach in 1998. Not only was this the most ever for the reach but the most for any reach since monitoring began in 1986. The fledge ratio of 2.33 was the highest ever for the Gavins Point Reach and matched the 2.33 fledge ratio on Lewis & Clark Lake as the highest fledge ratio for any reach.

HABITAT MANAGEMENT

There was little need for extensive habitat development, enhancement, and maintenance activities for least terns and piping plovers in 1998. Three years of high flows created abundant habitat on the reservoirs and on the river reaches below the dams. Several small projects were conducted during the year. Summaries of the work are as follows.

Fort Peck River Reach: The 1998 habitat effort resulted in the restoration of eight acres of high water escape habitat on two islands at RM 1580.5. The habitat within the restored area had degraded from open sandbar to stands of willows and cottonwoods ranging from six to fifteen feet in height. Vegetation was sprayed with the herbicide Rodeo and then mowed down using brush hog mowers or rotary mowers. Woody species were mowed down to one to three inch tall stumps. Past work has shown that majority of the stumps will be buried by sand deposition. In addition to the above work 36 acres of vegetation were treated with Rodeo during the fall. These acres will be rehabilitated in 1999.

Lake Sakakawea Reach: An additional four acres of habitat was created in 1998 at the Steinke Bay Habitat Area. Work was begun in the spring with the removal of vegetation. The work was completed in the fall with the spreading of gravel on the site. In cooperation with the Bureau of Reclamation and the U.S. Fish & Wildlife Service a habitat creation project was conducted on Lake Audubon. The impoundment behind Dike 1A was dewatered and a one acre island was built using earthmoving equipment. This island will be maintained by fluctuating the water levels in the impoundment.

Periodically the island will be inundated to prevent vegetation from becoming established.

Lake Oahe Reach: During the fall of 1998, demolition work was conducted by the South Dakota National Guard to remove overburden on a portion of Mission Point Island. The purpose of the work was to enhance habitat suitability in the interior part of the island.

GIS & GPS: The use of geographic information systems (GIS) and global position systems (GPS) will be an integral component in developing the habitat management plan. The following are highlights in the use of this technology to benefit least terns and piping plovers.

1997 Digital Orthos: Digital orthos of the Gavins Point and Garrison Reaches were taken in August 1997 at the time of the high releases from the two dams. The digital orthos will quantify the minimal habitat available during this period.

1998 Digital Orthos: In May 1998, digital orthos were taken of the Gavins Point and Garrison Reaches. The following August digital orthos were taken of the Fort Peck Reach, the Fort Randall Reach, and the upper part of Lewis & Clark Lake. These digital orthos will quantify the abundant habitat created by the previous high releases.

1998 GPS Habitat Work: In May 33 miles of habitat on the Missouri River below Fort Peck Dam and 25 miles of habitat on the Missouri below Fort Randall Dam were mapped using GPS equipment. These maps will be used to complement the digital ortho maps.

MANAGEMENT ACTIONS

Several management actions were undertaken to protect nesting sites, increase productivity, and increase public awareness during 1998. Some of these measures have been ongoing for several years while others have been done on a limited basis. These management actions are discussed below.

Predator Aversion Measures

Predator exclosure cages are used to protect piping plover nests. Cages used on the Missouri River are constructed of either two inch by four inch or two inch by two inch welded wire mesh. Cages are two feet by two feet by two feet or three feet by three feet by three feet in size. The cages are held in place with electric fence t-posts or with fourteen inch wire j-stakes. Assembly and installation time is approximately five minutes. Cages are assembled on site during the time allowed for productivity monitoring activities. Hands are washed with no scent soap before the handling of any cage components. After cage installation the nest is monitored to ensure that the nesting adult returns to the nest. In the

event the adult would not enter the cage, the cage is removed. There was no occurrence in 1998 where an adult did not resume attending a caged nest.

At the beginning of the nesting season, cages were installed over plover nests on the Lake Sakakawea, Garrison, Lake Oahe and Gavins Point Reaches. It was subsequently decided that the abundant habitat afforded the best protection for the plover nests and that the cages might attract “smart” predators or curious humans. Therefor the practice of caging nests was discontinued for 1998.

Overall, 14% (20/233) of the piping plover nests on the Missouri River System were caged. Of the twenty plover nests that were caged, eleven successfully hatched for a hatching success of 55.0%. Of the caged nests that did not hatch one was lost to flooding, two to weather, one was abandoned, three were destroyed by undetermined causes, and two had unknown fates. Of the 213 plover nests that were not caged, 169 hatched for a hatching success of 79.3%. The uncaged nests fates were as follows; six were collected, eight were lost to flooding, one was lost to predation, two were lost to human disturbance, three were destroyed by weather events and one was lost to livestock disturbance. Three other nests were abandoned, two contained non-viable eggs, eleven were destroyed by undetermined causes, and five had unknown fates.

At Lake Sakakawea an electric barrier fence was constructed across a peninsula in the Steinke Bay area. This fence protected four piping plover nests on the peninsula until rising lake elevation shorted it out.

Restrictive Sign Posting and Fencing

Nest sites close to or within recreation areas or areas with the high potential for human disturbance were posted with signs restricting access. These signs informed the public of the presence of endangered species and prohibited entry into the restricted area. The restricted area could further be delineated with orange twine strung on wooden posts. A reach by reach description follows.

Fort Peck Lake Reach: Restriction signs were posted around Beach 1 to protect the plover nest there from vehicle traffic. This nest was subsequently lost to a weather event.

Lake Sakakawea Reach: Beaches near three recreation areas; Little Egypt, Tobacco Garden Bay, and Steinke Bay, were fenced off and restriction signs placed to protect plover and tern nests from vehicular and foot traffic. In addition to this a section of beach at Fort Stevenson State Park was cordoned off to keep vehicles away from a piping plover nest. An all terrain vehicle at Little Egypt destroyed a plover nest before the

restriction fence went up. The other nests and broods at the four sites survived the nesting season without human interference.

Garrison River Reach: Restricted access signs and orange twine barricades were set up on the sandbar at the Fort Lincoln site (RM 1310.0) to protect four tern and two plover nests. There were no reports of human disturbance at this site.

Lake Oahe Reach: A small sandbar at RM 1299.0 that was home to one tern nest was signed and twined due to its proximity to the Kimball Bottom boat ramp. Restriction signs were placed on Dredge Island (RM 1270.0) to protect the plover nests there but the island was not twined. The three tern nests on the island off of Mission Point were protected by restriction signs and orange twine barricades. A fence was constructed across the peninsula of Mission Point to prevent vehicle and livestock access to the beach that harbored a plover nest. None of the protected sites were known to have been disturbed by human activities.

Fort Randall Reach: A sandbar complex at RM 851.7 developed into a major tern and plover nesting site with fifteen tern and ten plover nests. Due to its location near two miles of summer homes on the Nebraska side of the Missouri and the Verdel boat ramp at RM 851.6 this sandbar complex in the past has been extensively used for recreation. Personnel from the Fort Randall Project placed restricted access signs and orange twine barricades around several of the nesting sites on the complex just before the Fourth of July holiday weekend. None of the sandbars were completely roped off, just enough to encompass the nesting sites and surrounding area. The restriction signs and orange twine barricades worked as there was no known instance of the nests or chicks being disturbed.

Lewis & Clark Lake Reach: A discussion was held during the nesting season on whether to post the large tern colonies at the Complex (RM 842.0), Sand Fly Island (RM 838.0) and Clubhouse (RM 832.2). It was decided that posting restriction signs and orange twine barricades might attract people to these otherwise isolated sites. Therefore no signs were posted. Subsequently, one plover nest, located on the southernmost sandbar of the Complex, was lost to human disturbance. There was no evidence that the other sandbars of the Complex, Sand Fly Island, and Clubhouse suffered from human disturbance.

Gavins Point Reach: Restricted access signs and orange twine barricades were set up to protect and delineate nesting grounds on sandbars at River Miles 804.4, 798.9, 789.0, 781.8, 766.2, and 756.5. There were no incidents of nest or brood disturbances at these sites.

Law Enforcement Patrols

With large numbers of terns and plovers nesting at sites at RM 851.7, 842.0, and 838.0 it was decided that law enforcement personnel would monitor these areas during the July 4 weekend. Personnel from the Omaha District T&E section and the South Dakota Game & Fish Department conducted the monitoring from July 3 through July 5. No incidents were observed. Several members of the public were questioned as to their awareness of the why the signs were placed on the sandbars. In general good feedback was received.

Nest Relocation

Relocating nests was undertaken to prevent the destruction of nests threatened by rising lake or river levels. Nests were moved using various techniques. After moving, the nest was observed to see if the adult found the new location. If the adult was unable to locate the new site the nest was returned to the old location and the move was re-attempted. In each case in 1998, the nesting adult was observed attending the moved nest.

Lake Sakakawea Reach: One plover nest at the Lake Jessie site was moved to a higher location to prevent inundation from Lake Sakakawea. Though the move was successful the nest was subsequently destroyed in a hail storm. Two eggs from a tern nest at Lake Jessie were found blown out of the nest bowl on July 15. The nest bowl could not be relocated so a new nest bowl was made and the eggs placed there. The adults were observed at the nest on July 21. However the nest was not relocated on August 6 and the nest was listed as fate unknown.

Fort Randall Reach: In late June releases were reduced from Fort Randall Dam in response to flooding on the Niobrara River. This reduction exposed areas of the sandbar complex at Verdel that normally are under water. Before normal releases were resumed the complex was surveyed and it was determined that two newly initiated tern nests could be endangered by the higher releases. One nest was found to have an elevation of eight inches above the river. This nest was moved fifteen feet and gained six inches. The adult readily found the relocated nest and resumed incubating the eggs. The second tern nest had a four inch elevation above the river. It was moved twenty feet and gained three inches elevation. The adult found the nest and returned to it. The adult was allowed to incubate the eggs for a half-hour before a second move was attempted. Due to the relatively flat relief of the sandbar the nest was moved eighty feet to gain seven inches of elevation. Again the adult found the relocated nest and returned to incubate the eggs. Both nests subsequently hatched.

Livestock Management

U.S. Fish & Wildlife Service personnel at Charles M. Russell National Wildlife Refuge continued the policy of delaying livestock grazing until July 15 on management units adjacent to Fort Peck Lake where nesting or attempted nesting has been documented.

Nest Location Data

Nest locations on the Fort Peck Lake, Lake Oahe, Fort Randall, Lewis & Clark Lake, and Gavins Point Reaches were GPSed during the nesting season. Maps will be created combining the nest site data with the nest card database to analyze colony site dynamics.

Public Awareness

Public awareness of least terns and piping plovers on the Missouri River System remains a high priority of the Corps management program and was accomplished by several means in 1998. This included interpretive programs at Corps of Engineers campgrounds, educational programs at area schools, newspaper articles, radio interviews, public service announcements, and information signs. Corps personnel at the Gavins Point Project assisted in a Project WILD workshop for 24 area schoolteachers. The workshop focus was the ecology of the Missouri River with Corps personnel giving presentations on the Threatened and Endangered Species Program.

Specimen Collection for Contaminate Analysis

Generally specimens were not collected during the 1998 nesting season. Addled and abandoned eggs were usually disposed of on site. Specimens were collected from the following reaches.

Lake Oahe Reach: On July 21, three recently hatched plover chicks were found dead at a site at RM 1190.1 and were collected. The adult plover at the site appeared sick and died two days later. The adult and an egg from the plover nest were collected. All were sent to the U.S. Fish & Wildlife Service lab at Madison, Wisconsin for analysis. On July 28 one adult tern, three plover chicks, and one sandpiper were found dead on East Porcupine Island (RM 1251.0). The adult tern and two of the plover chicks were collected and sent to the U.S. Fish & Wildlife Service lab in Wisconsin for analysis.

Gavins Point River Reach: One piping plover chick was collected from the Gavins Point Reach from a sandbar at RM 771.0.

University of Wisconsin Captive Rearing Study: Two piping plover chicks, and one piping plover egg were obtained during the captive rearing program at the Gavins Point Project and will be forwarded to respective federal contaminate labs for analysis.

SPECIAL STUDIES

Niobrara River Study: The Corps' funded study on the distribution, productivity and habitat use by least terns and piping plovers on the Niobrara River 1996-1997 was published in 1998. The abstract of the study may be found in Appendix C.

University of Wisconsin Captive Rearing Study: To fulfill condition 1.d.6 of subpermit 93-07 the Corps has contracted with the University of Wisconsin to conduct a study to evaluate the survival of released captive reared piping plovers as well as the survival of wild reared piping plover juveniles. The 1998 nesting season marked the first year of this three year study. All work was done in accordance with the conditions of the endangered species permit PRT-704930, subpermit 98-06, and under permits from the South Dakota Game, Fish & Parks Department and the Nebraska Game & Parks Commission. Egg collections, incubation of eggs, rearing of chicks, and releases of fledged juveniles were conducted according to approved protocols. (See *Captive Rearing Protocol* Appendix B in the Corps' Least Tern and Piping Plover Management Plan, 1998 Missouri River Operations.)

A total of 24 plover eggs from six nests were collected. These eggs were collected to prevent their loss from either inundation from rising water levels or from areas with a high potential for human disturbance. Of the 24 eggs that were collected 23 hatched for a hatching success of 95.8%. Of these 23 plover chicks, 21 fledged for a fledging success of 91.3%. All 21 of the captive reared juveniles were released into the wild. The table below contains a reach by reach account of the 1998 collection and captive rearing results.

Reach	Collected	Hatched	Released	Re/Hat
Fort Randall	8	8	8	100%
Lewis & Clark	12	11	11	100%
Gavins Point	4	4	2	50%
Total	24	23	21	91%

Following their acclimation in the flight pen, the fledged piping plovers were released on secure habitats in the wild. Prior to release, all piping plovers were banded with a stainless steel 1A USFWS band on their left tarsometatarsus and with a light blue Darvic™ flag on their right tibiotarsus. The broods were further distinguished with unique color markings applied to the flags. Eighteen of the twenty-one released plovers were equipped with radio transmitters to aid in tracking of the birds. The captive reared plovers were released on sandbars near areas that contained other wild reared juveniles. The captive reared plovers were released on the following dates and locations; three plovers on July 7 at RM 837.5, eight on July 20 at RM 780.5, four on July 24 at RM 839.5, two on August 16 at RM 841.5 and four on August 25 at RM 836.0. Observations of captive reared plovers after release ranged from zero to twenty-five days with the average being 5.2 days. There were three confirmed mortalities; all believed to be have been caused by avian predators.

A total of fourteen wild plover juveniles were captured, one by use of a dip net and thirteen by use of a noose carpet. The captures were at the following locations: one at RM 845.0, two at RM 842.0, one at RM 839.0, five at RM 838.0, four at RM 804.5 and one at RM 803.5. Eleven of the fourteen wild plover juveniles were banded with a stainless steel 1A USFWS band on their left tarsometatarsus. All fourteen had a light blue Darvic™ flag attached on their right tibiotarsus. The wild juveniles were further distinguished with unique color markings on the flags. Eleven of the fourteen weighed in excess of 40.0 gm. and these plovers were equipped radio transmitters. Observations of wild plover juveniles after banding and flagging ranged from two to thirty-five days with the average being 10.6 days. There was no observed mortality of wild plover juveniles.

Banded Bird Sightings

From 1995 through 1997 a total of 287 captive reared piping plovers have been released into the wild. These plovers were all banded with a USFWS band on their left tarsometatarsus and with a light blue Darvic™ flag on their right tibiotarsus. During the past year several banded and flagged plovers were observed. The sighting locations are as follows.

Texas: In January researchers studying wintering piping plovers on the Texas Gulf Coast observed a banded blue flagged plover on a beach near Galveston. No attempt was made to capture the blue flagged plover but it was believed to have been a captive reared plover based on the blue flagging.

Montana: During the week of June 7, a piping plover with a light blue flag was observed at the Bowdoin National Wildlife Refuge in Montana. Subsequently on June 29 a blue flagged plover was observed on Tern Island at the Nelson Reservoir of the Bowdoin National Wildlife Refuge. On June 30 and July 2 two piping plovers with light blue flags were observed on Pete's Island at the Nelson Reservoir of the Bowdoin National Wildlife Refuge. Refuge personnel believe these two plovers were distinct from the one seen on June 29 due to difference in the neck band size between the three plovers and differences in the coloration in the light blue flags. The flag on the June 29 plover was brighter than the flags seen on the June 30 plovers. None of the plovers were associated with a nest, but refuge personnel noted that one of the plovers did build a nest scrape and defended the area around the nest scrape. It is believed these three plovers are part of the group of sixteen captive reared plovers that were released at Bowdoin in July 1997.

Lake Sakakawea: On June 4 a plover was observed at Steinke Bay with the following band combination, a single green band on the lower left leg and two bands on the lower right leg. The top band was a split color of white or yellow over white. The bottom band was a split color of green over black. There was no USFWS band observed on the plover. This plover was not seen again during the nesting season.

Missouri River below Garrison Dam: On June 22 a plover wearing a sage green color band and a USFWS metal band was observed attending a nest at RM 1319.5. This plover was captured on June 26. A check of the band showed it originated from the USFWS North Dakota Ecological Office but no banding location has been identified. The plover was observed several times during the nesting season and successfully hatched the nest.

Lake Oahe: On June 23 a blue flagged plover was observed on the Cheyenne River Arm (RM 1110.0) of Lake Oahe. The plover was solitary and not associated with any nest. The plover was not seen again during the nesting season. With the blue flag, the plover is believed to be a captive reared bird. This was the only flagged plover seen on the nesting grounds that was not near a release site for captive reared birds. The closest release sites were the Missouri River below Garrison Dam at RM 1359.0, about 250 miles to the north, or the mouth of the Niobrara, about 270 miles to the southeast. On the same day (June 23) as the sighting of the blue flagged plover, a second banded plover was seen on Lake Oahe. This plover had a red band on the lower right leg and a white band on the lower left leg and was observed at RM 1289.3. The Texas research group has claimed this band combination.

Lewis & Clark Lake: On June 12 three banded plovers were observed on the large sandbar complex located at RM 842.0. Two of the plovers had a USFWS band on the left leg and one of these had a blue flag on the right leg. The third plover had a white band on the right lower leg, a black band on the left lower leg, and a red/white combination on the left upper leg. Both of the first two plovers were believed to have been captive reared birds, though only one of the plovers had a blue flag. The sandbar complex where the plovers were seen is very close (within three miles) of the mouth of the Niobrara River where 111 captive reared plovers were released from 1995 to 1997. The third plover was banded on the Texas Gulf Coast in December 1997. The bird was banded as part of study on piping plover wintering ground survival being conducted by Texas A&M - Kingsville. This plover was also associated with a nest that successfully hatched. Due to the large number of plovers at the sandbar complex and the time constraints on monitoring the site the other two plovers could not be associated with a nest. Though the three plovers were seen several times during the nesting season there was no attempt to capture the birds because of the disruption this activity would cause to the large number of nesting terns and plovers.

On July 10 a blue flagged plover with a USFWS band was observed at RM 844.0 between the mouth of the Niobrara River and the Niobrara boat ramp. The plover was observed feeding and eventually flew towards the Niobrara River. This plover is believed to be a different bird from the blue flagged plover seen at the sandbar complex at RM 842.2. That plover was seen earlier the same day at the RM 842.0 sandbar complex. Subsequent surveys of the Niobrara boat ramp area and the mouth of the Niobrara failed to find any blue flagged plovers.

Florida: On September 14 one of the wild reared juvenile plovers banded as a part of the University of Wisconsin captive rearing study was observed on a beach at Honeymoon Island State Park Pinellas County Florida. Honeymoon Island is located on the Florida Gulf Coast, just north of Tampa Bay. The color combination on the band showed the plover was banded on July 30 on Sand Fly Island (RM 838.0). On November 16 a second wild reared juvenile was observed on a beach at Honeymoon Island State Park. The color combination on the band indicated the plover either was banded on July 8 near the Niobrara boat ramp at RM 842.0 or was banded on August 14 on Sand Fly Island. It is interesting that two juveniles on their first migration to the wintering grounds ended up on the Florida Gulf Coast.

On December 7 a third banded plover was observed at Honeymoon Island State Park. The metal band on its left leg and light blue flag on the right leg indicates the plover is one of the 287 captive reared plovers released from 1995 – 1997.

Thank you to the following Project Offices and their crews of dedicated staff who have diligently conducted the surveys, compiled the data, and submitted the annual field reports.

CHARLES M. RUSSELL REFUGE, FORT PECK - USFWS

FORT PECK PROJECT OFFICE

GARRISON PROJECT OFFICE

OAHE PROJECT OFFICE

CHEYENNE RIVER SIOUX TRIBE GAME, FISH & PARKS

FORT RANDALL PROJECT OFFICE

GAVINS POINT PROJECT OFFICE

UNIVERSITY OF WISCONSIN - MADISON

Casey D. Kruse

Senior Wildlife Biologist

Greg Pavelka

Wildlife Biologist

APPENDIX A

Nest Record & Adult Census Cards

NEST RECORD

SITE SUMMARY															
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
SPECIES			YEAR - RCH - NEST NO.						HABITAT		RIVER MILE				

LOCAL SITE NAME: _____

(For Reservoir Use Only)

17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33
1/4-1/4-1/4 SECTION						SECTION		TOWNSHIP			RANGE				STATE	

NEST DATA														
VISIT	DATE			OBSERVER			WEATHER		WHOLE EGGS		NEST STATUS			
	MO	DAY					TEMP	WIND	NO.	INCUB.				
34	35	36	37	38	39	40	41	42	43	44	45	46	47	48
<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

NEST SUMMARY										
49	50	51	52	53	54	55	56	57	58	59
<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
NEST INITIATION			NEST FATE		CAUSE		PRED	EGGS HATCH		EGGS ADDLED
									CHICKS FLEDGED	

MANAGEMENT ACTIVITIES				COMMENTS:
60	61	62	63	
ACT	DATE			

NEST SITE MAP

NEST RECORD PROCEDURES

SITE SUMMARY

Species: Boxes 1-3

A.O.U. Species #

277 - Piping Plover

074 - Least Tern

Nest ID:

Boxes 4-5: Year (Last 2 numbers)

Box 6: Reach ID

Reach nest is located in

1 - Fort Peck Lake

2 - Fort Peck River

3 - Lake Sakakawea

4 - Garrison River

6 - Lake Oahe

7 - Fort Randall River

8 - Lewis & Clark Lake

9 - Gavins Point River

Boxes 7-9: Nest Number

Habitat: Boxes 10-11

Nest Site Habitat

River Systems

01 - Sandbar

02 - Riverbank

03 - Island

04 - Island Beach

05 - Other

Reservoir Systems

06 - Peninsula/Point Beach

07 - Island

08 - Island Beach

09 - Linear Shoreline Beach

10 - Other

River Mile: Boxes 12-16

River Mile of nest site to the nearest 10th of a mile

Site Name: Name of Site or nearest major feature (Reservoir)

Legal Description: Boxes 17-31

Legal Description of Nest Site (Reservoir)

State: Boxes 32-33

2 letter State ID

NEST DATA

Visit: Box 34

Number of Nest Visit

T = Final Nest Visit

Date: Boxes 35-37

Date of Nest Visit

Observer: Boxes 38-40

Observer's Initials

Weather

Temp: Boxes 41-42

Temp to the nearest 5°F

Wind: Boxes 43-44

Wind to nearest 5 MPH

Whole Eggs No: Box 45

No. of eggs in nest

Incub.: Boxes 46-47

Incubation Stage

(See Diagram Below)

00 - Laying Stage

nn - Number Days Inc.

44 - Egg(s) Pipped

55 - Egg(s) Hatched

Nest Status: Box 48

Status of Nest

0 - Unknown

1 - Undisturbed/Normal

2 - Abandoned

3 - Eggs missing from previous visit

4 - Hatched

5 - Destroyed

6 - Other (Explain under Comments)

NEST SUMMARY

Nest Initiation: Boxes 49-51

Nest Initiation Date

Plovers (Complete Clutch):

Visit Date - $\{[(2x \# \text{ of eggs}) - 1] +$

Incubation Stage}

Terns (Complete Clutch):

Visit Date - $(\# \text{ of eggs} +$

Incubation Stage)

Nest Fate: Box 52

1 - Nest Hatched

2 - Nest Destroyed

3 - Nest Abandoned

4 - Nonviable Eggs

5 - Nest Fate Unknown

6 - Nest Collected

Cause: Boxes 53-54

Hatched

10 - Other (explain)

11 - Chicks in Bowl

12 - Chicks on Site

13 - Hatched Egg Shells

14 - Pipping Fragments

15 - Chick Droppings

16 - Incubator

Destroyed - Flooded

20 - Other (explain)

21 - Eggs Washed Out

22 - Nest filled, No eggs

23 - Flood Debris

Destroyed - Weather

30 - Other (explain)

31 - Eggs Suspended in Sand

32 - Eggs Smashed in Bowl

33 - Eggs Blown out of Bowl

Destroyed - Predator

40 - Other (explain)

41 - Tracks within 6F of Nest

42 - Destroyed Eggs

43 - Egg Yolk in Bowl

44 - Predator Observed

Destroyed - Other

50 - Sandbar Erosion

60 - Human Disturbance

70 - Unknown Causes

80 - Abandoned

90 - Livestock

Known Predator - Box 55

1 - Mink

2 - Raccoon

3 - Avian

4 - Reptile

5 - Other (Comments)

Reason for Pred ID - Box 56

1 - Predator observed

2 - Tracks near nest

3 - Dest. Egg Characteristics

Eggs Hatched - Box 57

Number of Eggs Hatched

Eggs Added - Box 58

Nonviable Eggs in Nest

Chicks Fledged - Box 59

From Productivity Record

MANAGEMENT

ACTIVITIES

Activity - Box 60

C - Plover Nest Caged

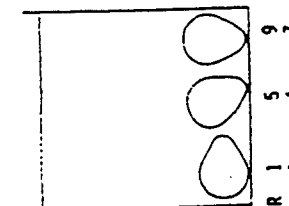
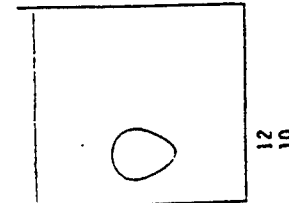
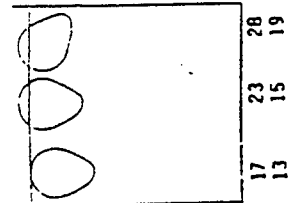
S - Strobe Light Installed

M - Nest Moved

O - Other (Explain under Comments)

Activity Date - Boxes 61-63

DAYS OF INCUBATION



ADULT CENSUS SITE RECORD WITH PRODUCTIVITY ESTIMATES

1 2 3 <div style="border: 1px solid black; width: 20px; height: 20px; display: inline-block;"></div>	SITE SUMMARY <div style="border: 1px solid black; width: 40px; height: 20px; display: inline-block;"></div>			4 5 <div style="border: 1px solid black; width: 20px; height: 20px; display: inline-block;"></div>	6 7 <div style="border: 1px solid black; width: 20px; height: 20px; display: inline-block;"></div>	8 9 <div style="border: 1px solid black; width: 20px; height: 20px; display: inline-block;"></div>	
SITE				MONTH	DAY	YEAR	
10 <div style="border: 1px solid black; width: 20px; height: 20px; display: inline-block;"></div>	11 <div style="border: 1px solid black; width: 20px; height: 20px; display: inline-block;"></div>	12 13 <div style="border: 1px solid black; width: 20px; height: 20px; display: inline-block;"></div>	14 <div style="border: 1px solid black; width: 20px; height: 20px; display: inline-block;"></div>	15 16 <div style="border: 1px solid black; width: 20px; height: 20px; display: inline-block;"></div>	17 18 <div style="border: 1px solid black; width: 20px; height: 20px; display: inline-block;"></div>	19 20 21 <div style="border: 1px solid black; width: 20px; height: 20px; display: inline-block;"></div>	22 23 24 <div style="border: 1px solid black; width: 20px; height: 20px; display: inline-block;"></div>
SURVEY TYPE	SURVEY TECH	HABITAT	REACH	TEMP WEATHER	WIND	OBSERVERS INITIALS	

(For River Use)					(For Reservoir Use Only)											
25 26 27 28 29 <div style="border: 1px solid black; width: 20px; height: 20px; display: inline-block;"></div>	30 31 <div style="border: 1px solid black; width: 20px; height: 20px; display: inline-block;"></div>	32 33 34 35 <div style="border: 1px solid black; width: 20px; height: 20px; display: inline-block;"></div>	36 37 38 <div style="border: 1px solid black; width: 20px; height: 20px; display: inline-block;"></div>	39 40 <div style="border: 1px solid black; width: 20px; height: 20px; display: inline-block;"></div>	41 42 43 44 45 46 <div style="border: 1px solid black; width: 20px; height: 20px; display: inline-block;"></div>											
RIVER MILE	STATE	TOWNSHIP	RANGE	SECTION	1/4-1/4 SECTION											

PIPING PLOVERS			LEAST TERNS		
47 48 <div style="border: 1px solid black; width: 20px; height: 20px; display: inline-block;"></div>	49 50 <div style="border: 1px solid black; width: 20px; height: 20px; display: inline-block;"></div>	51 52 <div style="border: 1px solid black; width: 20px; height: 20px; display: inline-block;"></div>	53 54 <div style="border: 1px solid black; width: 20px; height: 20px; display: inline-block;"></div>	55 56 <div style="border: 1px solid black; width: 20px; height: 20px; display: inline-block;"></div>	57 58 <div style="border: 1px solid black; width: 20px; height: 20px; display: inline-block;"></div>
TOTAL ADULTS	NESTS	BROODS	TOTAL	NESTS	BROODS

PRODUCTIVITY RECORD

DATE			AGE OF CHICKS OBSERVED																
MO	DAY	SPECIES	0-5	5-7	7-10	10-15	15-20	20-24	FLEDGE										
59	60	61	62	63	64	65	66	67	68	69	70	71	72	73	74	75	76	77	78
<div style="border: 1px solid black; width: 20px; height: 20px;"></div>	<div style="border: 1px solid black; width: 20px; height: 20px;"></div>	<div style="border: 1px solid black; width: 20px; height: 20px;"></div>	<div style="border: 1px solid black; width: 20px; height: 20px;"></div>	<div style="border: 1px solid black; width: 20px; height: 20px;"></div>	<div style="border: 1px solid black; width: 20px; height: 20px;"></div>	<div style="border: 1px solid black; width: 20px; height: 20px;"></div>	<div style="border: 1px solid black; width: 20px; height: 20px;"></div>	<div style="border: 1px solid black; width: 20px; height: 20px;"></div>	<div style="border: 1px solid black; width: 20px; height: 20px;"></div>	<div style="border: 1px solid black; width: 20px; height: 20px;"></div>	<div style="border: 1px solid black; width: 20px; height: 20px;"></div>	<div style="border: 1px solid black; width: 20px; height: 20px;"></div>	<div style="border: 1px solid black; width: 20px; height: 20px;"></div>	<div style="border: 1px solid black; width: 20px; height: 20px;"></div>	<div style="border: 1px solid black; width: 20px; height: 20px;"></div>	<div style="border: 1px solid black; width: 20px; height: 20px;"></div>	<div style="border: 1px solid black; width: 20px; height: 20px;"></div>	<div style="border: 1px solid black; width: 20px; height: 20px;"></div>	
<div style="border: 1px solid black; width: 20px; height: 20px;"></div>	<div style="border: 1px solid black; width: 20px; height: 20px;"></div>	<div style="border: 1px solid black; width: 20px; height: 20px;"></div>	<div style="border: 1px solid black; width: 20px; height: 20px;"></div>	<div style="border: 1px solid black; width: 20px; height: 20px;"></div>	<div style="border: 1px solid black; width: 20px; height: 20px;"></div>	<div style="border: 1px solid black; width: 20px; height: 20px;"></div>	<div style="border: 1px solid black; width: 20px; height: 20px;"></div>	<div style="border: 1px solid black; width: 20px; height: 20px;"></div>	<div style="border: 1px solid black; width: 20px; height: 20px;"></div>	<div style="border: 1px solid black; width: 20px; height: 20px;"></div>	<div style="border: 1px solid black; width: 20px; height: 20px;"></div>	<div style="border: 1px solid black; width: 20px; height: 20px;"></div>	<div style="border: 1px solid black; width: 20px; height: 20px;"></div>	<div style="border: 1px solid black; width: 20px; height: 20px;"></div>	<div style="border: 1px solid black; width: 20px; height: 20px;"></div>	<div style="border: 1px solid black; width: 20px; height: 20px;"></div>	<div style="border: 1px solid black; width: 20px; height: 20px;"></div>	<div style="border: 1px solid black; width: 20px; height: 20px;"></div>	
<div style="border: 1px solid black; width: 20px; height: 20px;"></div>	<div style="border: 1px solid black; width: 20px; height: 20px;"></div>	<div style="border: 1px solid black; width: 20px; height: 20px;"></div>	<div style="border: 1px solid black; width: 20px; height: 20px;"></div>	<div style="border: 1px solid black; width: 20px; height: 20px;"></div>	<div style="border: 1px solid black; width: 20px; height: 20px;"></div>	<div style="border: 1px solid black; width: 20px; height: 20px;"></div>	<div style="border: 1px solid black; width: 20px; height: 20px;"></div>	<div style="border: 1px solid black; width: 20px; height: 20px;"></div>	<div style="border: 1px solid black; width: 20px; height: 20px;"></div>	<div style="border: 1px solid black; width: 20px; height: 20px;"></div>	<div style="border: 1px solid black; width: 20px; height: 20px;"></div>	<div style="border: 1px solid black; width: 20px; height: 20px;"></div>	<div style="border: 1px solid black; width: 20px; height: 20px;"></div>	<div style="border: 1px solid black; width: 20px; height: 20px;"></div>	<div style="border: 1px solid black; width: 20px; height: 20px;"></div>	<div style="border: 1px solid black; width: 20px; height: 20px;"></div>	<div style="border: 1px solid black; width: 20px; height: 20px;"></div>	<div style="border: 1px solid black; width: 20px; height: 20px;"></div>	
<div style="border: 1px solid black; width: 20px; height: 20px;"></div>	<div style="border: 1px solid black; width: 20px; height: 20px;"></div>	<div style="border: 1px solid black; width: 20px; height: 20px;"></div>	<div style="border: 1px solid black; width: 20px; height: 20px;"></div>	<div style="border: 1px solid black; width: 20px; height: 20px;"></div>	<div style="border: 1px solid black; width: 20px; height: 20px;"></div>	<div style="border: 1px solid black; width: 20px; height: 20px;"></div>	<div style="border: 1px solid black; width: 20px; height: 20px;"></div>	<div style="border: 1px solid black; width: 20px; height: 20px;"></div>	<div style="border: 1px solid black; width: 20px; height: 20px;"></div>	<div style="border: 1px solid black; width: 20px; height: 20px;"></div>	<div style="border: 1px solid black; width: 20px; height: 20px;"></div>	<div style="border: 1px solid black; width: 20px; height: 20px;"></div>	<div style="border: 1px solid black; width: 20px; height: 20px;"></div>	<div style="border: 1px solid black; width: 20px; height: 20px;"></div>	<div style="border: 1px solid black; width: 20px; height: 20px;"></div>	<div style="border: 1px solid black; width: 20px; height: 20px;"></div>	<div style="border: 1px solid black; width: 20px; height: 20px;"></div>	<div style="border: 1px solid black; width: 20px; height: 20px;"></div>	
<div style="border: 1px solid black; width: 20px; height: 20px;"></div>	<div style="border: 1px solid black; width: 20px; height: 20px;"></div>	<div style="border: 1px solid black; width: 20px; height: 20px;"></div>	<div style="border: 1px solid black; width: 20px; height: 20px;"></div>	<div style="border: 1px solid black; width: 20px; height: 20px;"></div>	<div style="border: 1px solid black; width: 20px; height: 20px;"></div>	<div style="border: 1px solid black; width: 20px; height: 20px;"></div>	<div style="border: 1px solid black; width: 20px; height: 20px;"></div>	<div style="border: 1px solid black; width: 20px; height: 20px;"></div>	<div style="border: 1px solid black; width: 20px; height: 20px;"></div>	<div style="border: 1px solid black; width: 20px; height: 20px;"></div>	<div style="border: 1px solid black; width: 20px; height: 20px;"></div>	<div style="border: 1px solid black; width: 20px; height: 20px;"></div>	<div style="border: 1px solid black; width: 20px; height: 20px;"></div>	<div style="border: 1px solid black; width: 20px; height: 20px;"></div>	<div style="border: 1px solid black; width: 20px; height: 20px;"></div>	<div style="border: 1px solid black; width: 20px; height: 20px;"></div>	<div style="border: 1px solid black; width: 20px; height: 20px;"></div>	<div style="border: 1px solid black; width: 20px; height: 20px;"></div>	
<div style="border: 1px solid black; width: 20px; height: 20px;"></div>	<div style="border: 1px solid black; width: 20px; height: 20px;"></div>	<div style="border: 1px solid black; width: 20px; height: 20px;"></div>	<div style="border: 1px solid black; width: 20px; height: 20px;"></div>	<div style="border: 1px solid black; width: 20px; height: 20px;"></div>	<div style="border: 1px solid black; width: 20px; height: 20px;"></div>	<div style="border: 1px solid black; width: 20px; height: 20px;"></div>	<div style="border: 1px solid black; width: 20px; height: 20px;"></div>	<div style="border: 1px solid black; width: 20px; height: 20px;"></div>	<div style="border: 1px solid black; width: 20px; height: 20px;"></div>	<div style="border: 1px solid black; width: 20px; height: 20px;"></div>	<div style="border: 1px solid black; width: 20px; height: 20px;"></div>	<div style="border: 1px solid black; width: 20px; height: 20px;"></div>	<div style="border: 1px solid black; width: 20px; height: 20px;"></div>	<div style="border: 1px solid black; width: 20px; height: 20px;"></div>	<div style="border: 1px solid black; width: 20px; height: 20px;"></div>	<div style="border: 1px solid black; width: 20px; height: 20px;"></div>	<div style="border: 1px solid black; width: 20px; height: 20px;"></div>	<div style="border: 1px solid black; width: 20px; height: 20px;"></div>	

Additional Record Space on Back



US Army Corps
of Engineers



Threatened & Endangered
Species Program 1994

79 80

PLOVERS
FLEDGE

81 82

TERNS
FLEDGE

CENSUS RECORD PROCEDURES

THE SUMMARY

- Box 1
River Reach (See Box 14)
- Box 2-3
Site Number
- Box 4-9
Date of Census
- Box 10
Survey Type
- 1 Walking
 - 2 Automobile
 - 3 Boat
 - 4 Airplane/Helicopter
 - 5 Other (explain)
- Box 11
Survey Technique
- 1 Total Adult Count
 - 2 Visual Estimate
 - 3 Best Guess Estimate
 - 4 2X Nests + Broods
(Must Fill in boxes 50-53 & 56-59)
- Box 12-13
Habitat Type
- 01 Sandbar
 - 02 Beach
 - 03 Island
 - 04 Peninsula
 - 05 Feeding/Flying
 - 10 Other (explain)

- Box 14
Reach Site Located In
- 1 Fort Peck Reservoir
 - 2 Fort Peck River
 - 3 Lake Sakakawea
 - 4 Garrison River
 - 5 ~~Lake Oahe, ND~~
 - 6 Lake Oahe, SD
 - 7 Fort Randall River
 - 8 Lewis & Clark Res.
 - 9 Gavins Point River

- Box 15-16
Temp to Nearest 5° F
- Box 17-18
Wind to Nearest 5 mph
- Box 19-24
All Observers Initials

- Box 25-29
River Mile of Colony Site to Nearest 10th of Mile
- Box 30-46
Legal Description of Colony Site (Reservoirs)

- Box 51-52
Number of Plover Broods on Site
- Box 53-54
Total Adult Terns Observed on Site
- Box 55-56
Number of Active Tern Nests on Site
- Box 57-58
Number of Tern Broods on Site

PRODUCTIVITY RECORD

- Box 59-61
Date of Site Visit
- Box 62-64
277 Piping Plover
074 Least Tern
- Box 65-78
Age of Chicks Observed
(Use separate row for each species)
- Box 79-82
Total Plovers and Terns Fledged at the Site
- Box 83-88
Computer Generated

CENSUS

- Box 47-48
Total Adult Plovers Observed on Site
- Box 49-50
Number of Active Plover Nests on Site

REMARKS:

PIPING PLOVER *****									
Downy			*****			Feathered			*****
			*****						*****
			*****						*****
LEAST TERN			*****			*****			*****
			Downy			Feathered			Fledged
			*****			*****			*****
			*****			Fledged			*****
			*****			*****			*****
			*****			*****			*****
			*****			*****			*****
			*****			*****			*****
			*****			*****			*****
			*****			*****			*****
			*****			*****			*****
			*****			*****			*****
			*****			*****			*****
			*****			*****			*****
			*****			*****			*****
			*****			*****			*****
			*****			*****			*****
			*****			*****			*****
			*****			*****			*****
			*****			*****			*****
			*****			*****			*****
			*****			*****			*****
			*****			*****			*****
			*****			*****			*****
			*****			*****			*****
			*****			*****			*****
			*****			*****			*****
			*****			*****			*****
			*****			*****			*****
			*****			*****			*****
			*****			*****			*****
			*****			*****			*****
			*****			*****			*****
			*****			*****			*****
			*****			*****			*****
			*****			*****			*****
			*****			*****			*****
			*****			*****			*****
			*****			*****			*****
			*****			*****			*****
			*****			*****			*****
			*****			*****			*****
			*****			*****			*****
			*****			*****			*****
			*****			*****			*****
			*****			*****			*****
			*****			*****			*****
			*****			*****			*****
			*****			*****			*****
			*****			*****			*****
			*****			*****			*****
			*****			*****			*****
			*****			*****			*****
			*****			*****			*****
			*****			*****			*****
			*****			*****			*****
			*****			*****			*****
			*****			*****			*****
			*****			*****			*****
			*****			*****			*****
			*****			*****			*****
			*****			*****			*****
			*****			*****			*****
			*****			*****			*****
			*****			*****			*****
			*****			*****			*****
			*****			*****			*****
			*****			*****			*****
			*****			*****			*****
			*****			*****			*****
			*****			*****			*****
			*****			*****			*****
			*****			*****			*****
			*****			*****			*****
			*****			*****			*****
			*****			*****			*****
			*****			*****			*****
			*****			*****			*****
			*****			*****			*****
			*****			*****			*****
			*****			*****			*****
			*****			*****			*****
			*****			*****			*****
			*****			*****			*****
			*****			*****			*****
			*****			*****			*****
			*****			*****			*****
			*****			*****			*****
			*****			*****			*****
			*****			*****			*****
			*****			*****			*****
			*****			*****			*****
			*****			*****			*****
			*****			*****			*****
			*****			*****			*****
			*****			*****			*****
			*****			*****			*****
			*****			*****			*****
			*****			*****			*****
			*****			*****			*****
			*****			*****			*****
			*****			*****			*****
			*****			*****			*****
			*****			*****			*****
			*****			*****			*****
			*****			*****			*****
			*****			*****			*****
			*****			*****			*****
			*****			*****			*****
			*****			*****			*****
			*****			*****			*****
			*****			*****			*****
			*****			*****			*****
			*****			*****			*****
			*****			*****			*****
			*****			*****			*****
			*****			*****			*****
			*****			*****			*****
			*****			*****			*****
			*****			*****			*****
			*****			*****			*****

APPENDIX B

Site by Site Productivity Records

MISSOURI RIVER LEAST TERN PRODUCTIVITY MONITORING & ADULT CENSUS, 1998.

REACH	RIVER MILE	LAKE LOCATION	NESTS	NEST HAT.	NEST SUCC.	EGGS	HAT.	EGGS	FLOOD	PRED.	FATE DESTROYED	LIVE STOCK	WTHR.	UNKN.	DES.	FATE UNKN.	ABAN.	NON VIABL.	ADULT CENSUS	CHICKS FLEDGE	FLEDGE RATIO
	797.0		0	0	0.0	0	0	0	0	0	0	0	0	0	0	0	0	0	4	0	0.00
	790.0		6	5	83.3	12	9	0	0	0	0	0	0	0	0	0	1	0	4	8	4.00
	789.0		10	9	90.0	29	26	0	0	0	0	0	0	1	0	0	0	0	18	26	2.89
	787.5		0	0	0.0	0	0	0	0	0	0	0	0	0	0	0	0	0	2	0	0.00
	781.8		9	8	88.9	23	21	0	0	0	0	0	0	1	0	0	0	0	18	19	2.11
	781.5		5	5	100.0	14	14	0	0	0	0	0	0	0	0	0	0	0	10	13	2.60
	778.0		2	2	100.0	5	5	0	0	0	0	0	0	0	0	0	0	0	4	4	2.00
	777.7		6	5	83.3	15	13	0	0	0	0	0	0	0	0	0	1	0	8	13	3.25
	776.7		1	1	100.0	2	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0.00
	775.2		2	0	0.0	6	0	0	0	0	0	0	0	0	0	0	0	0	4	0	0.00
	770.6		1	1	100.0	2	2	0	0	0	0	0	0	0	0	0	0	0	2	3	3.00
	770.0		5	4	80.0	12	10	0	0	0	0	0	0	0	0	0	0	0	8	9	2.25
	766.2		10	8	80.0	25	19	0	0	0	0	0	0	1	0	0	1	0	14	19	2.71
	761.5		0	0	0.0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0.00
	760.5		0	0	0.0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0.00
	760.0		1	1	100.0	3	3	0	0	0	0	0	0	0	0	0	0	0	4	3	1.50
	756.5		15	12	80.0	38	29	0	0	0	0	0	0	0	0	0	1	0	24	28	2.33
TOTAL			83	70	84.3	214	178	0	0	0	0	0	0	0	0	8	5	0	144	168	2.33
TOTAL			342	282	82.5	864	696	1	1	1	1	0	6	0	0	36	14	1	631	538	1.71

*Census only, site not monitored for pro

MISSOURI RIVER LEAST TERN PRODUCTIVITY MONITORING & ADULT CENSUS, 1998.

REACH	RIVER MILE	LAKE LOCATION	NESTS		NEST SUCC.	EGGS		FLOOD	PRED.	FATE DESTROYED				LIVE STOCK		WTHR.	DES. FATE			ADULT CENSUS	CHICKS FLEDGE	FLEDGE RATIO
			HAT.	NEST		HAT.	EGGS			H.DIST.	BANK E.	E. STOCK	UNKN.	UNKN.	ABAN.		VIABL					
FTPKRES		BEACH 37	2	1	0.0	6	3	0	0	0	0	0	0	0	0	1	0	0	4			
FTPKRIV	1716.1*		0	0	0.0	0	0	0	0	0	0	0	0	0	0	1	0	0	1	0	0.00	
	1712.5		1	1	100.0	3	3	0	0	0	0	0	0	0	0	2	0	0	2	3	3.00	
	1699.8		0	0	0.0	0	0	0	0	0	0	0	0	0	0	1	0	0	1	0	0.00	
	1689.9		4	3	75.0	12	9	0	0	0	0	0	0	0	0	8	0	0	8	9	2.25	
	1685.7		1	0	0.0	3	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.00	
	1682.2		1	1	100.0	2	1	0	0	0	0	0	0	0	0	2	0	0	2	0	0.00	
	1674.8		1	1	100.0	3	3	0	0	0	0	0	0	0	0	3	0	0	3	0	0.00	
	1671.7		0	0	0.0	0	0	0	0	0	0	0	0	0	0	1	0	0	1	0	0.00	
	1663.4*		0	0	0.0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.00	
	1628.0*		0	0	0.0	0	0	0	0	0	0	0	0	0	0	2	0	0	2	0	0.00	
	1580.5		3	2	66.7	5	4	0	1	0	0	0	0	0	0	3	0	0	3	4	2.67	
	1578.5		0	0	0.0	0	0	0	0	0	0	0	0	0	0	1	0	0	1	0	0.00	
TOTAL			11	8	72.7	28	20	0	1	0	0	0	0	0	2	0	0	25	16		1.52	
LKSKRES																						
GARRRIV	1370.0	LAKE JESSIE TOBACCO GARDEN LITTLE FIELD BAY FOX ISLAND	16	11	68.8	39	23	0	0	0	0	0	0	0	0	14	0	0	14	3	0.43	
	1366.0		2	2	100.0	6	5	0	0	0	0	0	0	0	0	7	0	0	7	5	1.43	
	1364.3		1	1	100.0	3	2	0	0	0	0	0	0	0	0	2	0	0	2	2	2.00	
	1362.0		1	1	100.0	2	2	0	0	0	0	0	0	0	0	0	0	0	0	2	0.00	
	1358.0		20	15	75.0	50	32	0	0	0	0	0	0	0	0	23	0	0	23	12	1.04	
	1349.7		10	9	90.0	24	20	0	0	0	0	0	0	0	0	22	0	0	22	22	2.00	
	1347.4		1	0	0.0	3	0	0	0	0	0	0	0	0	0	2	0	0	2	0	0.00	
	1339.1		6	6	100.0	14	14	0	0	0	0	0	0	0	0	10	0	0	10	14	2.80	
	1336.5		8	5	62.5	21	13	0	0	0	0	0	0	0	0	16	0	0	16	10	1.25	
	1334.2		7	7	100.0	14	14	0	0	0	0	0	0	0	0	14	0	0	14	15	2.14	
	1324.5		6	5	83.3	18	15	0	0	0	0	0	0	0	0	12	0	0	12	12	2.00	
	1321.1		3	2	66.7	9	6	0	0	0	0	0	0	0	0	6	0	0	6	4	1.33	
1319.5	1	0	0.0	2	0	0	0	0	0	0	0	0	0	2	0	0	2	0	0.00			
1310.0	0	0	0.0	0	0	0	0	0	0	0	0	0	0	3	0	0	3	0	0.00			
1307.3	11	8	72.7	23	17	0	0	0	0	0	0	0	0	1	0	0	14	5	0.71			
1302.3	3	2	66.7	8	5	0	0	0	0	0	0	0	0	0	8	0	0	8	5	1.25		
TOTAL			73	57	78.1	181	140	0	0	0	0	0	0	0	11	2	0	141	107		1.52	
LKOHRES	1299.0	KIMBALL ISLAND	1	1	100.0	3	3	0	0	0	0	0	0	0	0	5	0	0	5	1	0.40	
	1295.3	SUGARLOAF	3	3	100.0	9	9	0	0	0	0	0	0	0	0	9	0	0	9	5	1.11	
	1294.8	SUGARLOAF EAST	2	2	100.0	5	5	0	0	0	0	0	0	0	0	4	0	0	4	1	0.50	

MISSOURI RIVER PIPING PLOVER PRODUCTIVITY MONITORING & ADULT CENSUS, 1998.

REACH	RIVER	LAKE	LOCATION	NESTS	NEST	NEST	SUCC.	EGGS	EGGS	EGGS	HAT.	HAT.	FLOOD	PRED.	H. DIST.	WTHR.	LIVEST	BANK	DES.	FATE	ABAN.	NON	ADULT	CHICKS	COLL.	FLEDGE
LKOHRES	MILE			HAT.	COLL.	COLL.												EROS.	UNKN.	UNKN.		VABLE	CENSUS	FLEDGE	RELEASES	RATIO
	1295.3	SUGAR LOAF	1	1	0	100.0	4	4	0	0	0	0	0	0	0	0	0	0	0	0	0	0	5	0	0	0.00
	1294.8	SUGAR LOAF EAST	1	1	0	100.0	4	4	0	0	0	0	0	0	0	0	0	0	0	0	0	0	5	0	0	0.00
	1289.3	HUFF	2	0	0	0.0	6	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	5	0	0	0.00
	1285.0	HUFF SOUTH	2	2	0	100.0	5	5	0	0	0	0	0	0	0	0	0	0	0	0	0	0	5	0	0	0.00
	1270.0	DREDGE ISLAND	9	8	0	88.9	32	28	0	0	0	0	0	0	0	1	0	0	0	0	0	0	14	12	0	2.00
	1251.2	PORCUPINE WEST	3	3	0	100.0	10	10	0	0	0	0	0	0	0	0	0	0	0	0	0	0	7	4	0	1.71
	1251.2	PORCUPINE EAST	2	2	0	100.0	8	8	0	0	0	0	0	0	0	0	0	0	0	0	0	0	8	1	0	1.14
	1229.0	KENEL FLATS	3	1	0	33.3	9	1	0	0	0	0	0	0	0	0	0	0	2	0	0	0	12	0	0	0.25
	1227.3	KENEL FLATS	2	1	0	50.0	7	3	0	0	0	0	0	0	0	0	0	0	1	0	0	0	2	1	0	1.00
	1223.0		0	0	0	0.0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2	0	0	0	0.00
	1194.0		1	0	0	0.0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.00
	1190.3	BLUE BLANKET	2	2	0	100.0	7	6	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.00
	1159.0	SWIFTBIRD	1	1	0	100.0	4	3	0	0	0	0	0	0	0	0	0	0	0	0	0	0	3	1	0	0.67
	1158.8	SWIFTBIRD	1	1	0	100.0	4	4	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2	3	0	3.00
	1158.3	SWIFTBIRD SOUTH	1	1	0	100.0	4	4	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2	3	0	3.00
	1158.0	SWIFTBIRD SOUTH	1	1	0	100.0	4	4	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2	3	0	3.00
	1149.5*		0	0	0	0.0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2	0	0	0.00
	1149.0*		0	0	0	0.0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2	0	0	0.00
	1110.0	CHEYENNE RIVER	3	3	0	100.0	7	7	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0.00
	1109.5	LITTLE BEND	3	3	0	100.0	11	11	0	0	0	0	0	0	0	0	0	0	0	0	0	0	7	5	0	1.43
	1105.0	MISSION CREEK N	1	0	0	0.0	4	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	6	8	0	2.67
	1104.0	MISSION CREEK	1	1	0	100.0	4	4	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2	0	0	0.00
	1092.0	DRY CREEK	1	1	0	100.0	4	4	0	0	0	0	0	0	0	0	0	0	0	0	0	0	3	4	0	2.67
	1091.0	PLUM CREEK	0	0	0	0.0	4	4	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2	4	0	4.00
			0	0	0	0.0	4	4	0	0	0	0	0	0	0	0	0	0	0	0	0	0	3	0	0	0.00
TOTAL			41	33	0	80.5	139	110	0	0	0	0	0	0	0	1	1	0	2	2	1	1	98	51	0	1.04
FTRNRV	869.0		1	1	0	100.0	3	3	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2	0	0	0.00
	867.1		1	1	0	100.0	5	4	0	0	0	0	0	0	0	0	0	0	0	0	0	0	4	2	0	1.00
	866.7		1	1	0	100.0	4	4	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2	0	0	0.00
	851.9		1	1	0	100.0	4	4	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2	0	0	0.00
	851.7		9	6	2	66.7	36	24	8	8	8	8	1	0	0	0	0	0	0	0	0	0	18	13	8	1.50
	848.5		1	1	0	100.0	4	4	0	0	0	0	0	0	0	0	0	0	0	0	0	0	3	3	0	1.44
																										2.00
TOTAL			14	11	2	78.6	56	43	8	8	8	8	1	0	0	0	0	0	0	0	0	0	33	21	8	1.27
LECLRES	843.0	NIORARA	5	1	0	20.0	15	2	0	0	0	0	0	0	0	0	0	0	2	1	1	0	4	2	0	1.00
	842.2	THE COMPLEX	23	21	1	91.3	86	71	4	4	4	4	0	0	0	1	0	0	0	0	0	0	2	4	0	4.00
	839.3		1	1	0	100.0	4	4	0	0	0	0	0	0	0	0	0	0	0	0	0	0	46	57	4	2.48
	838.0	SAND FLY	9	8	0	88.9	28	27	0	0	0	0	0	0	0	0	0	0	0	0	0	1	2	4	0	4.00
	837.8		1	1	0	100.0	3	3	0	0	0	0	0	0	0	0	0	0	0	0	0	0	13	18	0	2.77
	836.2		1	1	0	100.0	3	3	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2	3	0	3.00
	836.0		2	2	0	100.0	8	7	0	0	0	0	0	0	0	0	0	0	0	0	0	0	3	3	0	2.00
	832.2	CLUBHOUSE	2	2	0	100.0	7	6	0	0	0	0	0	0	0	0	0	0	0	0	0	0	4	3	0	1.50
	828.7		1	1	0	100.0	3	3	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2	5	0	5.00
	828.4		3	1	2	33.3	12	4	8	7	0	0	0	0	0	0	0	0	0	0	0	0	4	2	0	1.00
TOTAL			49	40	3	81.6	173	134	12	11	0	0	0	0	1	0	0	0	2	1	2	0	84	103	11	2.45
GAPTRV	807.4		2	1	0	50.0	8	4	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2	3	0	3.00
	804.4		6	3	1	50.0	23	14	4	4	0	0	0	1	0	0	0	0	1	0	0	0	10	9	2	1.80
	803.5		1	1	0	100.0	4	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2	1	0	1.00
	798.9		1	0	0	0.0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0.00
	796.3		1	1	0	100.0	4	4	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2	1	0	1.00

MISSOURI RIVER PIPING PLOVER PRODUCTIVITY MONITORING & ADULT CENSUS, 1998.

REACH	RIVER MILE	LAKE LOCATION	NESTS	NEST HAT.	NEST COLL.	NEST SUCC.	EGGS HAT.	EGGS COLL.	FLOOD	FATE DESTROYED	LIVEST	BANK EROS.	DES. UNKN.	FATE UNKN.	ABAN.	NON VIABLE	ADULT CENSUS	CHICKS RELEASED	COLL.	FLEDGE RATIO
FTPKLAK		BEACH 1	1	0	0	0.0	4	0	0	0	1	0	0	0	0	0	2	0	0	0.00
		BEACH 5	1	1	0	100.0	4	4	0	0	0	0	0	0	0	0	2	0	0	0.00
TOTAL			2	1	0	50.0	8	4	0	0	1	0	0	0	0	0	4	0	0	0.00
FTPKRIV	1674.8		1	1	0	100.0	4	4	0	0	0	0	0	0	0	0	2	0	0	0.00
	1580.5		2	1	0	50.0	5	3	0	0	0	0	1	0	0	0	2	2	0	2.00
TOTAL			3	2	0	66.7	9	7	0	0	0	0	1	0	0	0	4	2	0	1.00
LKSKRES		LAKE JESSIE	3	1	0	33.3	11	4	0	0	1	0	0	0	0	0	4	4	0	2.00
		TOBACCO GARDEN	2	2	0	100.0	8	8	0	0	0	0	0	0	0	0	4	8	0	4.00
		LITTLE EGYPT	2	1	0	50.0	7	4	0	0	1	0	0	0	0	0	2	4	0	4.00
		CHARLSON	0	0	0	0.0	0	0	0	0	0	0	0	0	0	0	1	0	0	0.00
		WHITE EARTH W	1	1	0	100.0	3	3	0	0	0	0	0	0	0	0	2	0	0	0.00
		WHITE EARTH	2	1	0	50.0	6	3	0	0	0	0	1	0	0	0	5	3	0	1.20
		ANTELOPE CREEK	0	0	0	0.0	0	0	0	0	0	0	0	0	0	0	1	0	0	0.00
		ANTELOPE FLAT E	1	1	0	100.0	4	4	0	0	0	0	0	0	0	0	2	0	0	0.00
		BEACON ISLAND	1	1	0	100.0	4	4	0	0	0	0	0	0	0	0	4	4	0	2.00
		LITTLE FIELD	2	2	0	100.0	7	7	0	0	0	0	0	0	0	0	4	4	0	2.00
		VAN HOOK	3	3	0	100.0	9	7	0	0	0	0	0	0	0	0	6	3	0	1.00
		PARSHALL BAY	2	1	0	50.0	7	3	0	0	0	0	0	0	0	0	6	0	0	0.00
		DEEPWATER BAY	8	6	0	75.0	23	18	0	0	0	0	0	0	0	0	16	15	0	1.88
		INDEPENDENCE PT	1	1	0	100.0	2	2	0	0	0	0	0	0	0	0	2	0	0	0.00
		NISHU BAY	3	2	0	66.7	8	5	0	0	0	0	0	0	0	0	4	0	0	0.00
		DOUGLAS CREEK	5	2	0	40.0	19	7	0	0	0	0	1	0	0	0	10	4	0	0.80
		LUTHERAN CAMP	2	2	0	100.0	6	6	0	0	0	0	0	0	0	0	4	6	0	3.00
		FORT STEVENSON	2	2	0	100.0	5	5	0	0	0	0	0	0	0	0	4	1	0	0.50
		STEINKE BAY	12	7	0	58.3	45	23	0	0	0	0	3	1	1	0	11	10	0	1.82
		WEST TOTTEN	4	3	0	75.0	12	8	0	0	0	0	0	1	0	0	9	0	0	0.00
		MALLARD ISLAND	4	4	0	100.0	7	7	0	0	0	0	0	0	0	0	8	1	0	0.25
		EMBANKMENT IS	2	1	0	50.0	3	2	0	0	0	0	0	0	0	0	4	0	0	0.00
		AUDUBON	2	2	0	100.0	7	7	0	0	0	0	0	0	0	0	6	7	0	2.33
TOTAL			64	46	0	71.9	203	137	0	0	1	1	5	2	1	0	119	74	0	1.24
GARRRIV	1377.4		1	1	0	100.0	4	3	0	0	0	0	0	0	0	0	2	3	0	3.00
	1370.0		2	2	0	100.0	7	7	0	0	0	0	0	0	0	0	4	7	0	3.50
	1364.3		2	2	0	100.0	7	5	0	0	0	0	0	0	0	0	4	5	0	2.50
	1362.0		4	4	0	100.0	15	14	0	0	0	0	0	0	0	0	12	7	0	1.17
	1358.0		5	5	0	100.0	18	16	0	0	0	0	0	0	0	0	10	11	0	2.20
	1349.7		3	3	0	100.0	12	12	0	0	0	0	0	0	0	0	7	9	0	2.57
	1347.4		1	0	0	0.0	4	0	0	0	0	0	0	0	0	0	5	0	0	0.00
	1339.1		1	0	0	0.0	4	0	0	0	0	0	1	0	0	0	2	0	0	0.00
	1334.2		1	1	0	100.0	4	4	0	0	0	0	0	0	0	0	3	3	0	2.00
	1327.7		1	1	0	100.0	3	3	0	0	0	0	0	0	0	0	1	3	0	6.00
	1324.5		1	1	0	100.0	4	4	0	0	0	0	0	0	0	0	2	4	0	4.00
	1321.1		1	0	0	0.0	4	0	0	0	0	0	0	0	0	0	1	0	0	0.00
	1319.5		4	3	0	75.0	16	12	0	0	0	0	0	0	0	0	9	10	0	2.22
	1310.0		2	1	0	50.0	8	4	0	0	0	0	0	1	0	0	4	2	0	1.00
	1307.3		1	1	0	100.0	4	4	0	0	0	0	0	0	0	0	4	3	0	1.50
	1302.3		2	2	0	100.0	5	5	0	0	0	0	0	0	0	0	4	1	0	0.50
TOTAL			32	27	0	84.4	119	93	0	0	0	0	1	1	0	1	74	68	0	1.84

MISSOURI RIVER PIPING PLOVER PRODUCTIVITY MONITORING & ADULT CENSUS, 1998.

REACH	RIVER MILE	LAKE LOCATION	NESTS HAT.	NEST COLL.	NEST SUCC.	EGGS HAT.	EGGS COLL.	EGGS HAT.	COLL. HAT.	FLOOD	FATE PRED.	H. DIST.	WTHR.	LIVEST	BANK EROS.	DES. UNKN.	FATE UNKN.	ABAN.	NON VIABLE	ADULT CENSUS	CHICKS FLEDGED	COLL. RELEASES	FLEDGE RATIO
	790.0		1	1	0	100.0	4	4	0	0	0	0	0	0	0	0	0	0	0	2	4	0	4.00
	789.0		1	1	0	100.0	4	4	0	0	0	0	0	0	0	0	0	0	0	2	4	0	4.00
	781.8		2	2	0	100.0	8	7	0	0	0	0	0	0	0	0	0	0	0	4	5	0	2.50
	781.5		2	1	0	50.0	6	3	0	0	0	0	0	0	0	1	0	0	0	2	3	0	3.00
	777.7		2	2	0	100.0	7	7	0	0	0	0	0	0	0	0	0	0	0	4	7	0	3.50
	775.2		1	1	0	100.0	4	3	0	0	0	0	0	0	0	0	0	0	0	2	1	0	1.00
	770.6		1	1	0	100.0	4	4	0	0	0	0	0	0	0	0	0	0	0	2	4	0	4.00
	770.0		1	1	0	100.0	4	4	0	0	0	0	0	0	0	0	0	0	0	2	2	0	2.00
	769.8		1	0	0	0.0	4	0	0	0	0	0	0	0	0	0	1	0	0	2	0	0	0.00
	769.0		1	0	0	0.0	4	0	0	0	0	0	0	0	0	0	0	0	1	2	0	0	0.00
	766.2		1	1	0	100.0	4	4	0	0	0	0	0	0	0	0	0	0	0	2	3	0	3.00
	760.0		1	1	0	100.0	2	2	0	0	0	0	0	0	0	0	0	0	0	2	2	0	2.00
	756.5		2	2	0	100.0	5	5	0	0	0	0	0	0	0	0	0	0	0	4	5	0	2.50
TOTAL			28	20	1	71.4	100	70	4	4	0	1	0	0	0	3	1	1	1	49	54	2	2.20
TOTAL			233	180	6	77.3	807	598	24	23	9	1	2	5	1	0	7	5	3	465	373	21	1.60

*Census only, site not monitored for productivity

APPENDIX C

Niobrara River Study Abstract

Abstract

DISTRIBUTION, PRODUCTIVITY, AND HABITAT USE BY INTERIOR LEAST TERNS AND PIPING PLOVERS ON THE NIOBRARA RIVER IN NORTHERN NEBRASKA, 1996- 1997

Stacy L. Adolf

1998

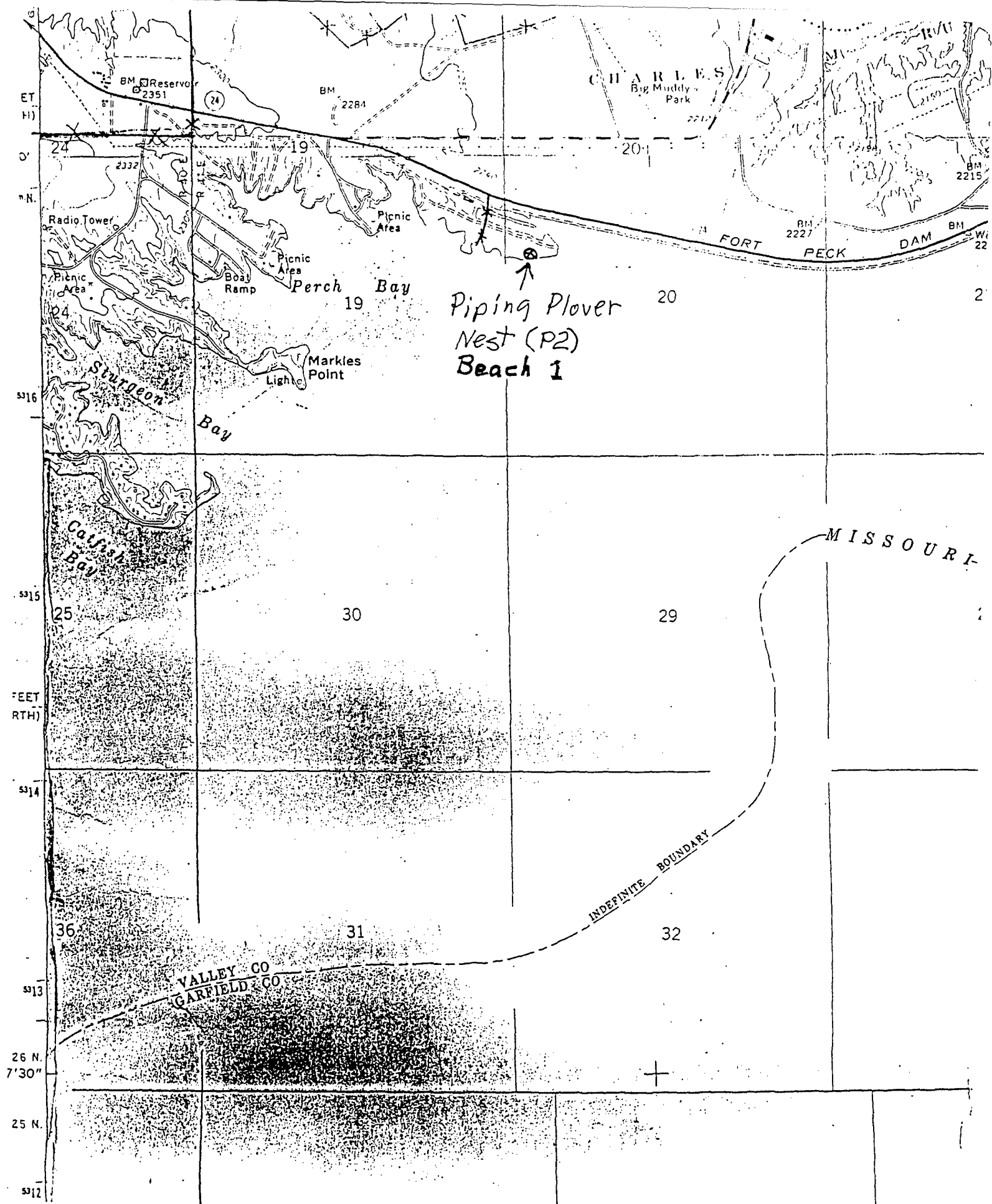
Interior least terns (*Sterna alltilarum athalassos*) and Piping Plovers (*Charadrius melodus*) are endangered and threatened species, respectively, and have been protected under the Endangered Species Act since 1985. Dam building on the Missouri River has produced changes in the availability and suitability of nesting habitats while both species continue to experience population declines throughout their range. The Niobrara River in Nebraska is one of the least modified rivers in the northern Great Plains that currently supports breeding populations of least terns and piping plovers. Evaluating the Niobrara River with its relatively undisturbed hydrologic regime provided information about least tern and piping plover habitat selection, productivity and distribution along a relatively natural river. Both species were first recorded nesting on the Niobrara River since before 1902 while in more recent years, this river has been identified as a significant production area. The Niobrara River was surveyed comprehensively during the summers of 1996 and 1997 for least terns and piping plovers. Nesting sites were identified and various nest site parameters were measured. Distribution of the nesting birds, productivity, nest success and habitat use were also evaluated. Aerial videography was flown for the Niobrara River in early June of 1996 and 1997. Sandbar characteristics including total area and areas of high, low, wet sand, and heavy vegetation were obtained from the videography. Least terns and piping plovers were found along the entire portion of the Niobrara River monitored in 1996 and 1997 and equaled 30% to 40% of the total Nebraska population. Piping plovers usually initiated nests earlier than least terns with terns being more synchronous nesters than plovers. Piping plover known fate nest success ranged from 54% in 1996 to 73% in 1997 while least tern nest success was 80% during the 1996 and 1997 breeding seasons. In 1996 and 1997 respectively, the majority of sandbars used for nesting by least terns also supported nesting piping plovers. Other analyses, including the aerial videography analysis, also suggested that terns and piping plovers were selecting for the same types of habitat. Least terns may also be keying in on the presence of piping plovers and decreased amounts of vegetative cover in their selection of islands for nesting. Piping plovers,

however, are selecting for high sand and the presence of heavy vegetative clumps on the sandbars. Using analysis of aerial videography, least terns were determined to need 1.3% of an islands total area in high sand and > 7% of low sand. Piping plovers also needed at least 1.3% of an island to be in high sand and > 9% of the total island area in low sand. Therefore, it is possible that one nesting habitat model based on piping plover selected characteristics could be developed and used to predict the use or non-use of a sandbar for nesting by both species.

APPENDIX D

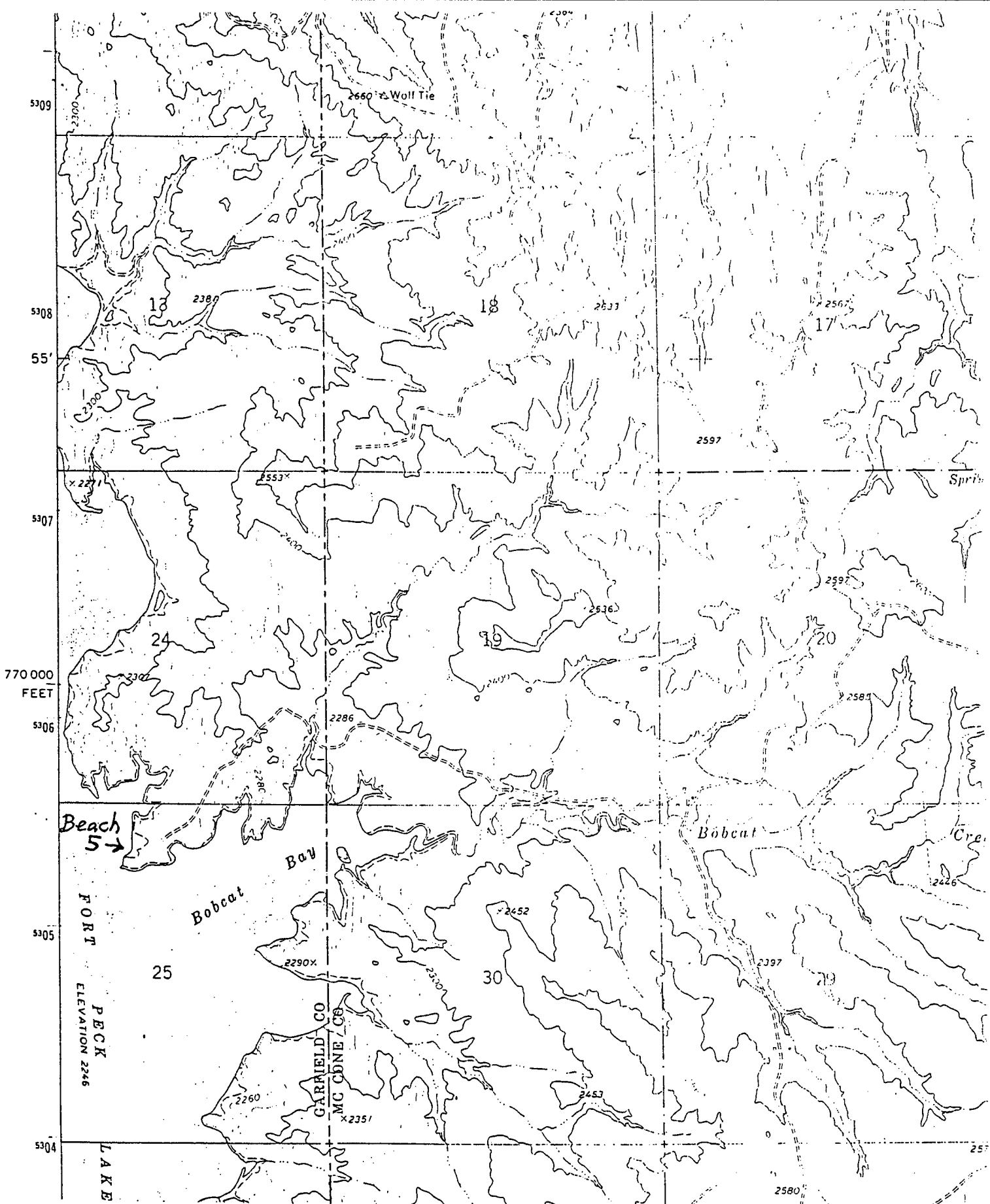
Nesting & Adult Census Site Maps

FORT PECK LAKE



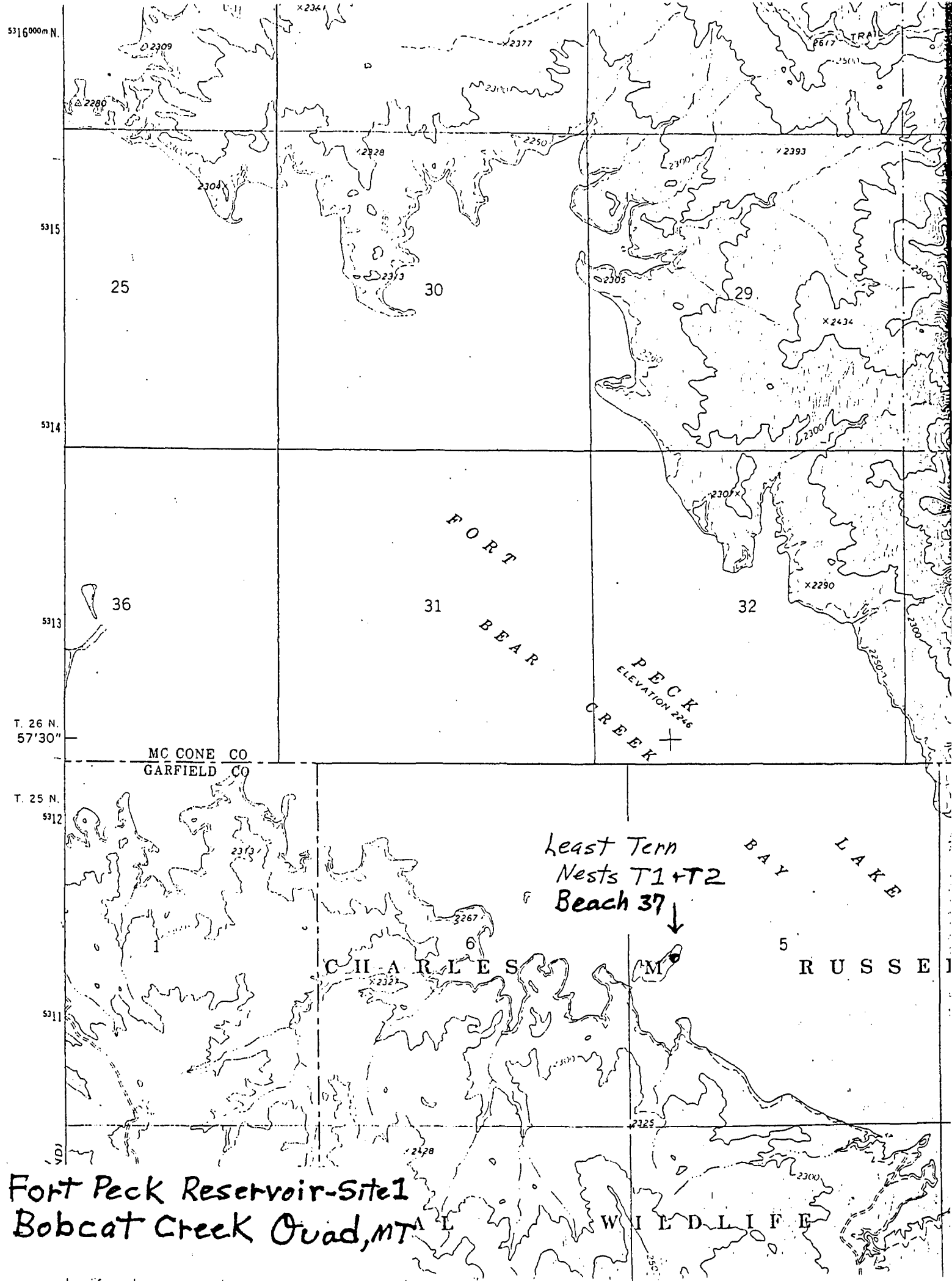
Fort Peck Reservoir-Site 1
York Island Quad, MT

F O R T P E C K
ELEVAT



Fort Peck Reservoir - Site 1
Bobcat Creek Quad, MT

Note: Piping Plover
Nest (P1) was not found but
the adults + 4 young were seen.
on Beach 5.



Fort Peck Reservoir-Site1
Bobcat Creek Quad, MT

FORT PECK RIVER

RM 1689.9
4 LT Nest

10

1690



13

14

15

ROOSEVELT CO
MC CONE CO

1692

1LT Nestle
RM 1712.5

RAGE
RATE

29

28

27

33

1711

32

1713

30

1714

31

1715

3

5

RM 1685.7
ILT Nest

1686

15

14

1684

13

22

23

POPLAR RIVER

RM 1682.2
ILT Nest

24

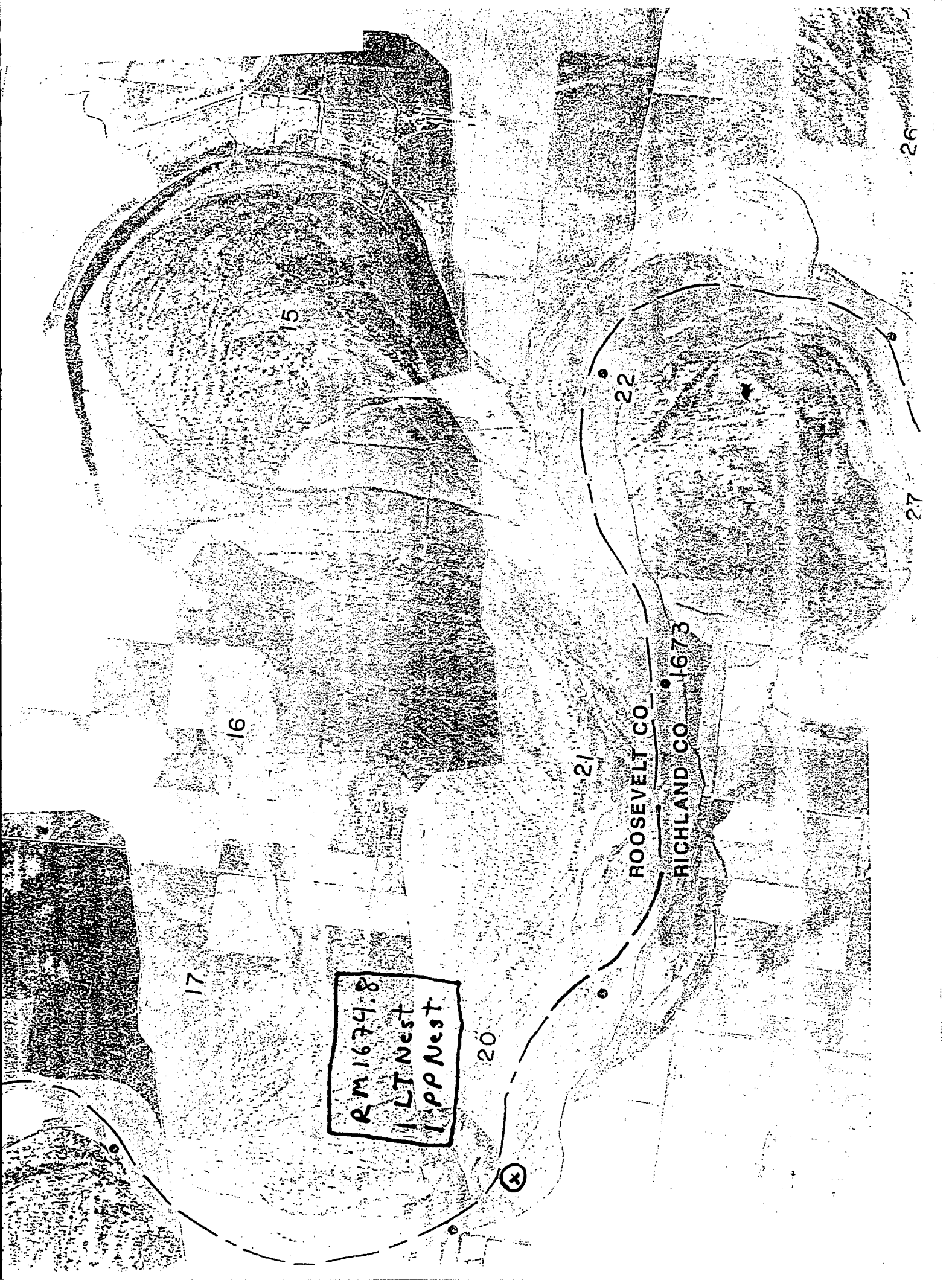
25

26

ROOSEVELT CO

RICHLAND

1681



R.M. 1674.8
1 LT Nest
1 PP Nest

ROOSEVELT CO.
RICHLAND CO. 1673

(10M 1954)

Quad Name- Buford

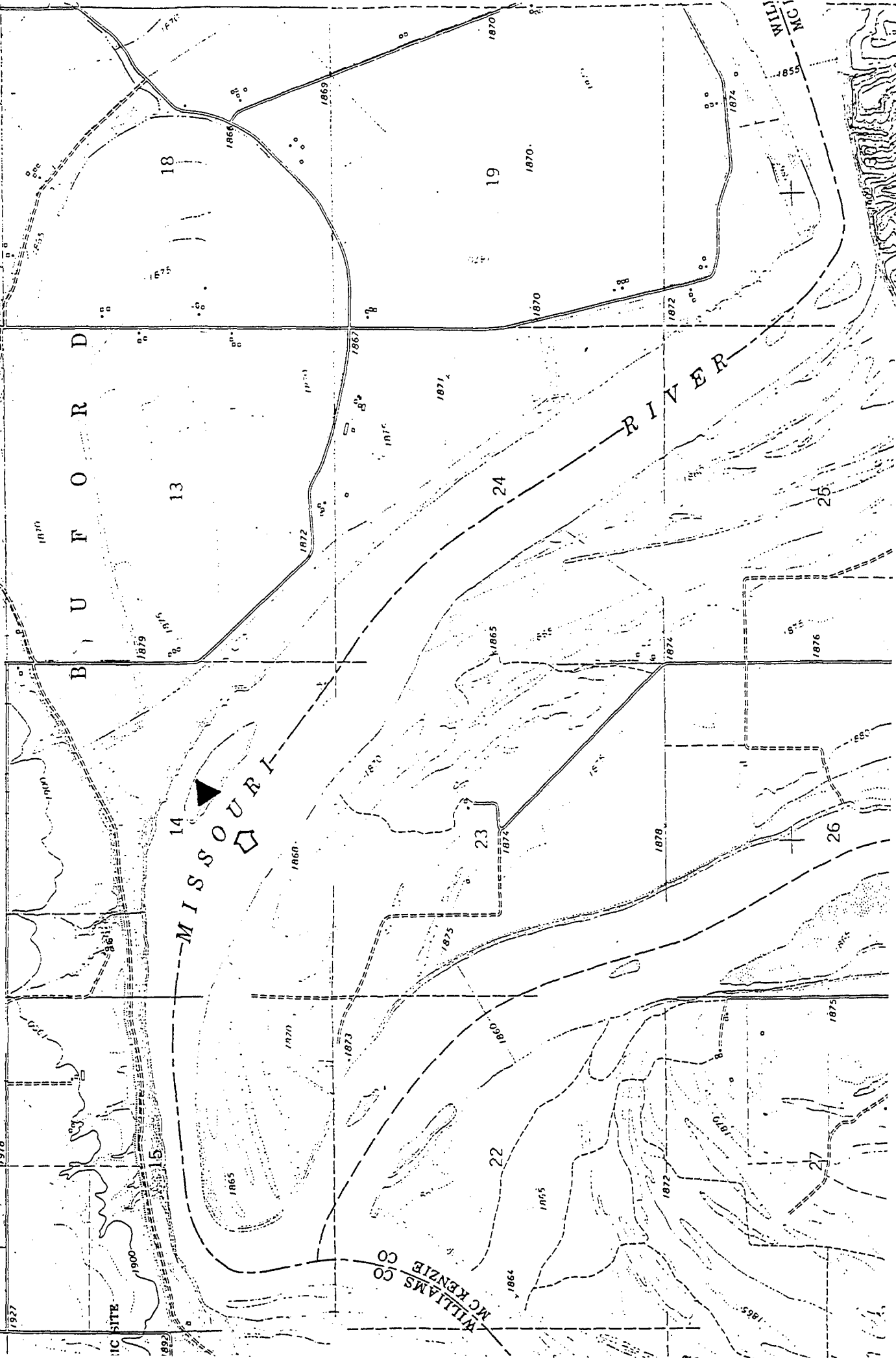
Site Name- Confluence

Nest #'s- 213, 214, 215, 216, 210

RM- 1580.5

T- 152N R-104W S-14 Co.- Williams

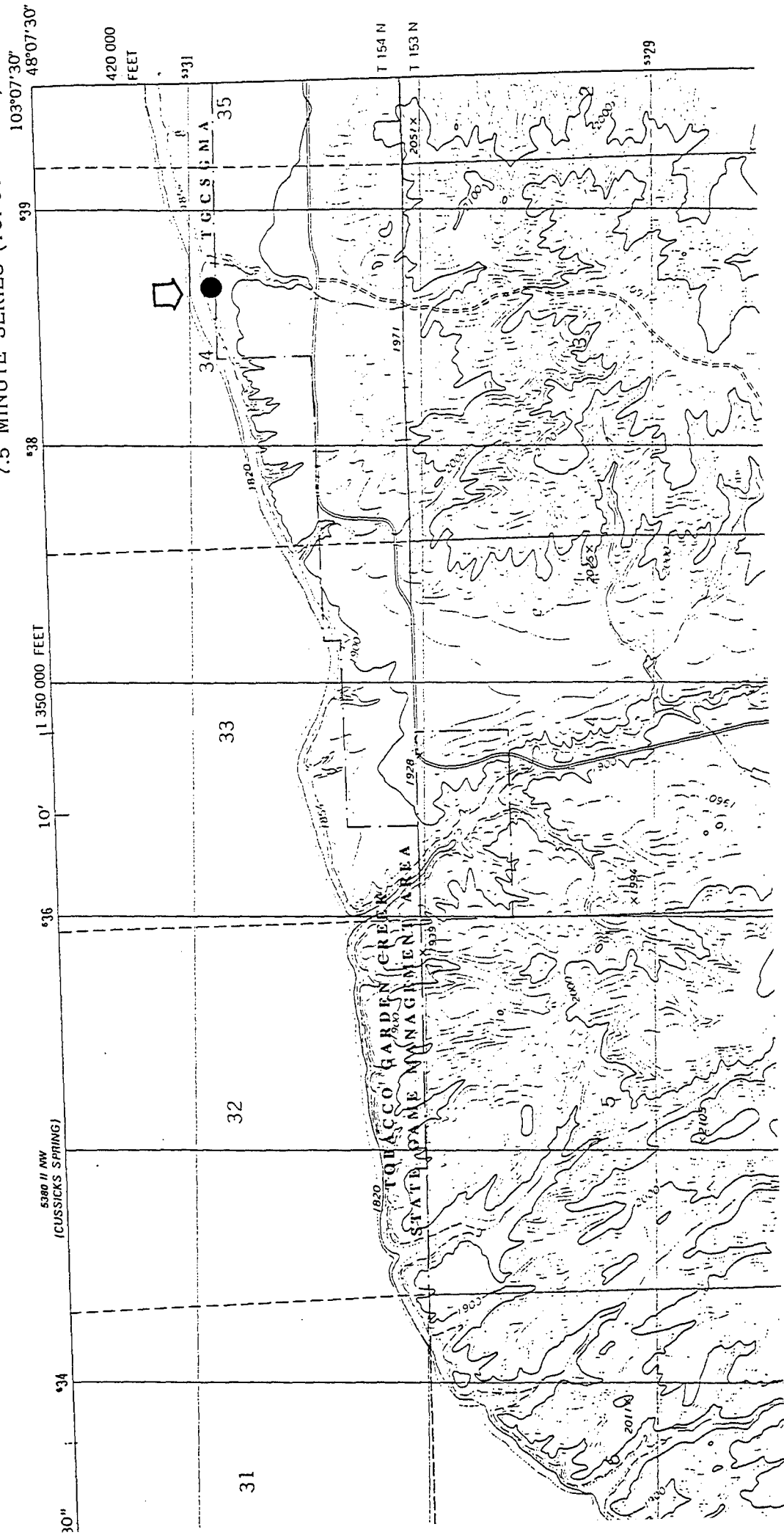
13-L.T. 2-P.P.

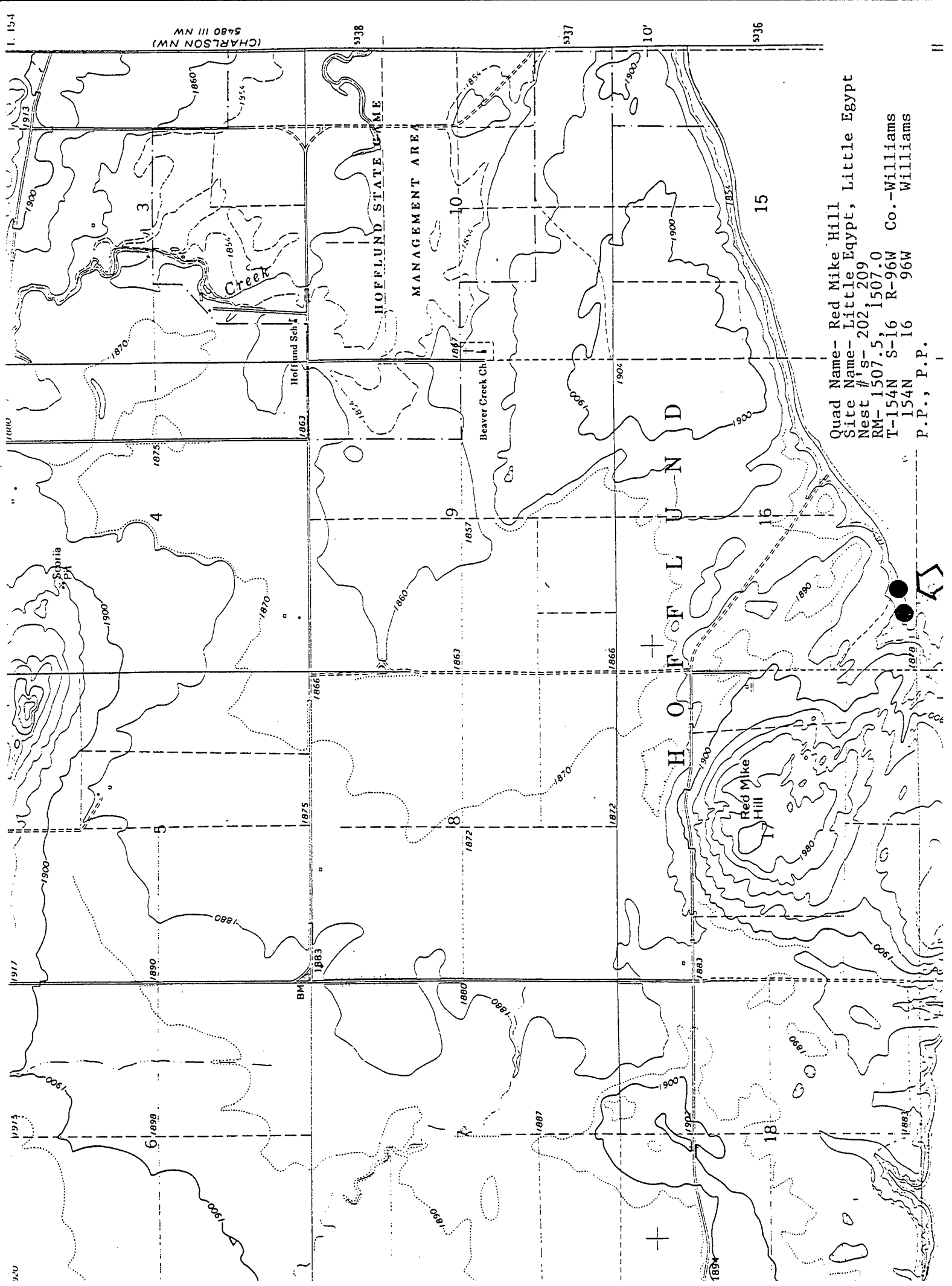


LAKE SAKAKAWEA

Quad Name- Banks
 Site Name- Tobacco Gardens
 Nest #- 203
 RM-1512
 T-154N S-34 R-97W Co.- McKenzie

BANKS QUADRANGLE
 NORTH DAKOTA
 7.5 MINUTE SERIES (TOPOGRAPHIC)



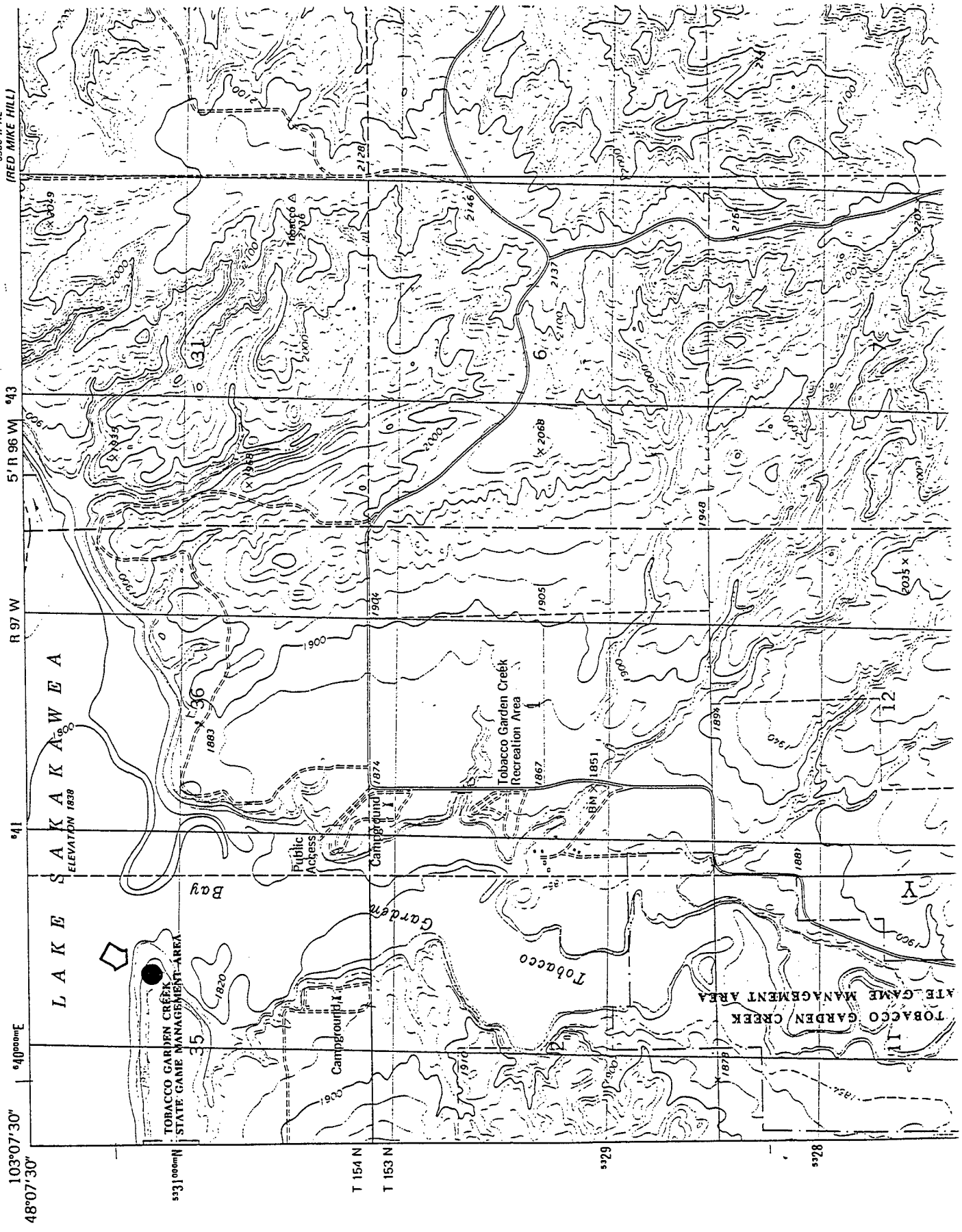


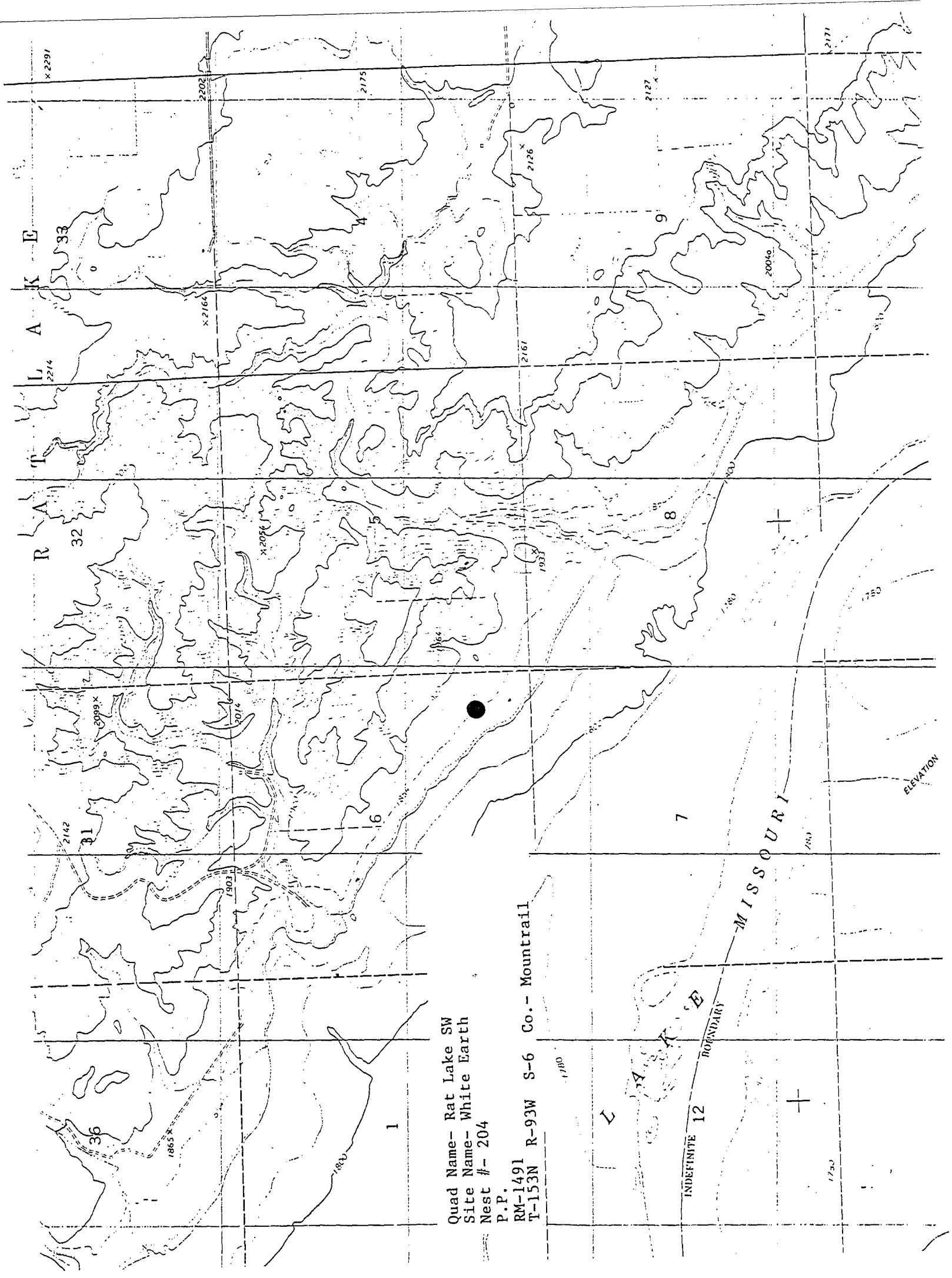
Quad Name- Red Mike Hill
Site Name- Little Egypt, Little Egypt
Nest #s- 202, 209
RM- 1507.5, 1507.0
T-154N S-16 R-96W Co.-Williams
154N 16 96W Williams
P.P., P.P.

5380 II NW
(CUSSICKS SPRING)

UNITED STATES
DEPARTMENT OF THE INTERIOR
GEOLOGICAL SURVEY

Site Name- Tobacco Gardens
Nest #'s- 210, 206, 207
RM-1511.6
T-154N R-96W S-35 Co.- McKenzie
P.P. L.T. L.T.



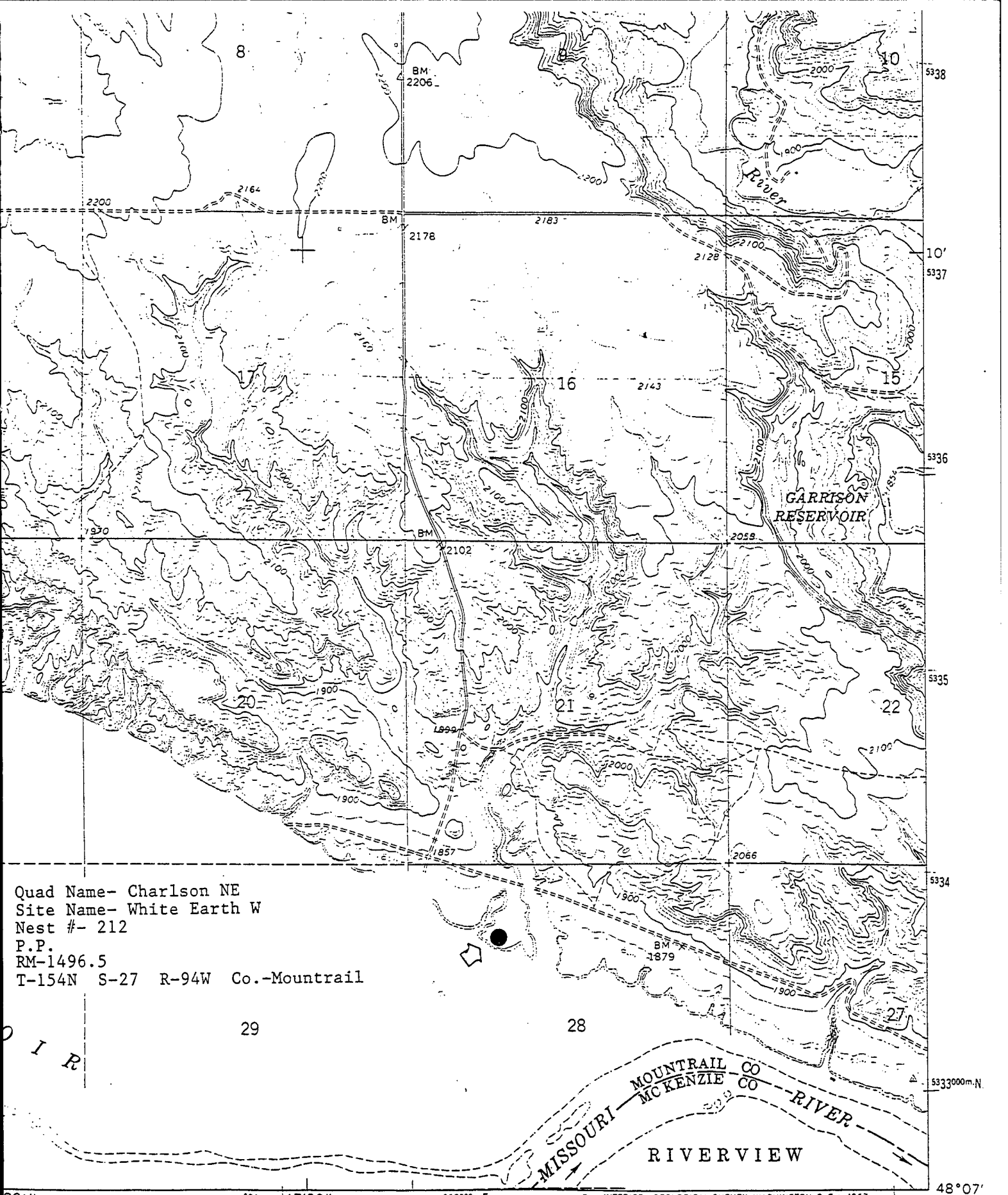


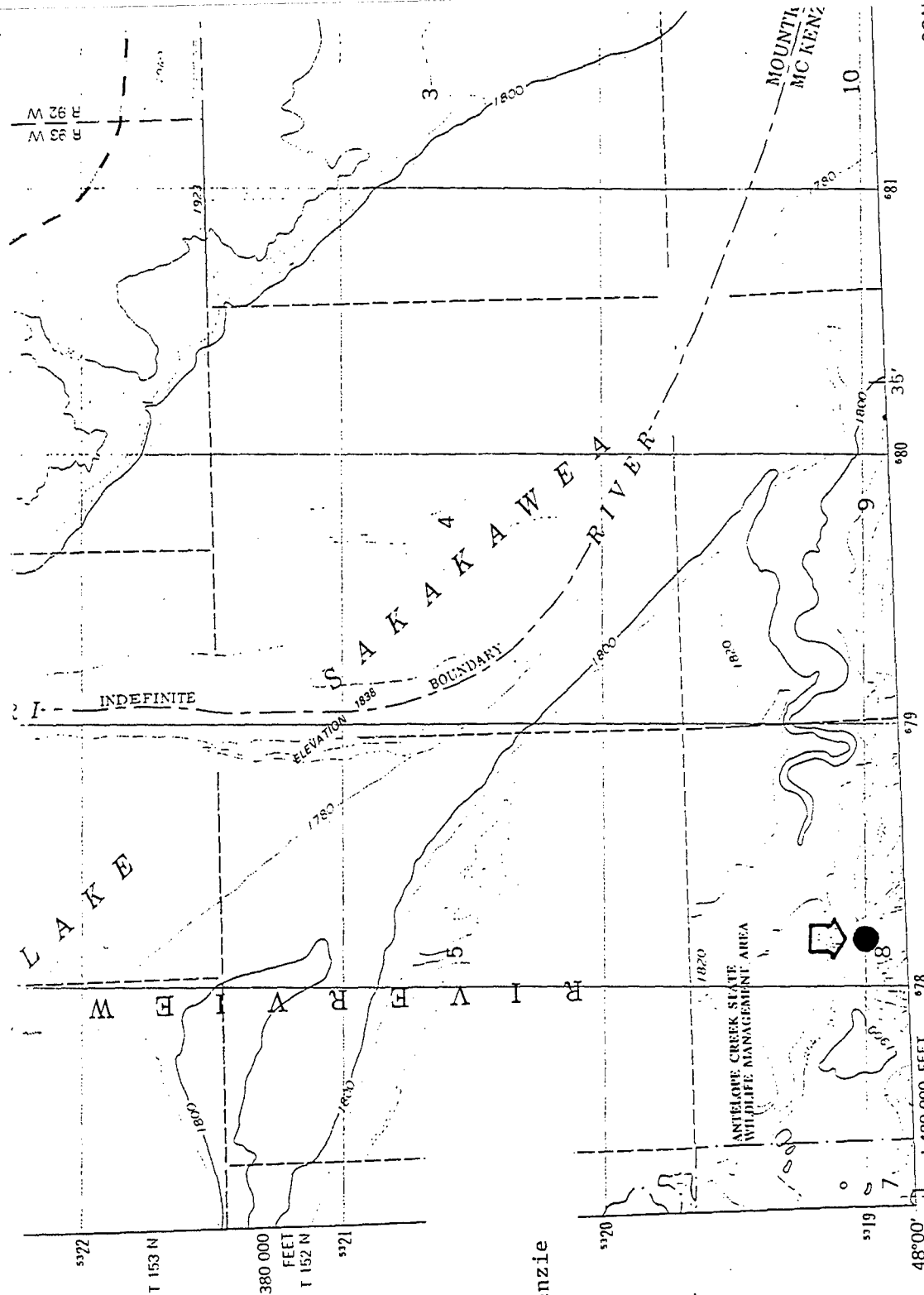
Quad Name- Rat Lake SW
Site Name- White Earth
Nest #- 204

P.P.

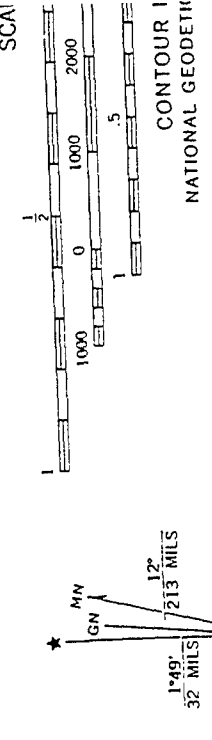
RM-1491

T-153N R-93W S-6 Co.- Mountrail





Quad Name- Rat Lake S.E.
 Site Name- E. Antelope Flats
 Nest- 211
 RM- 1484.4
 T- 152N S-8 R-93W Co.-McKenzie
 P.P.

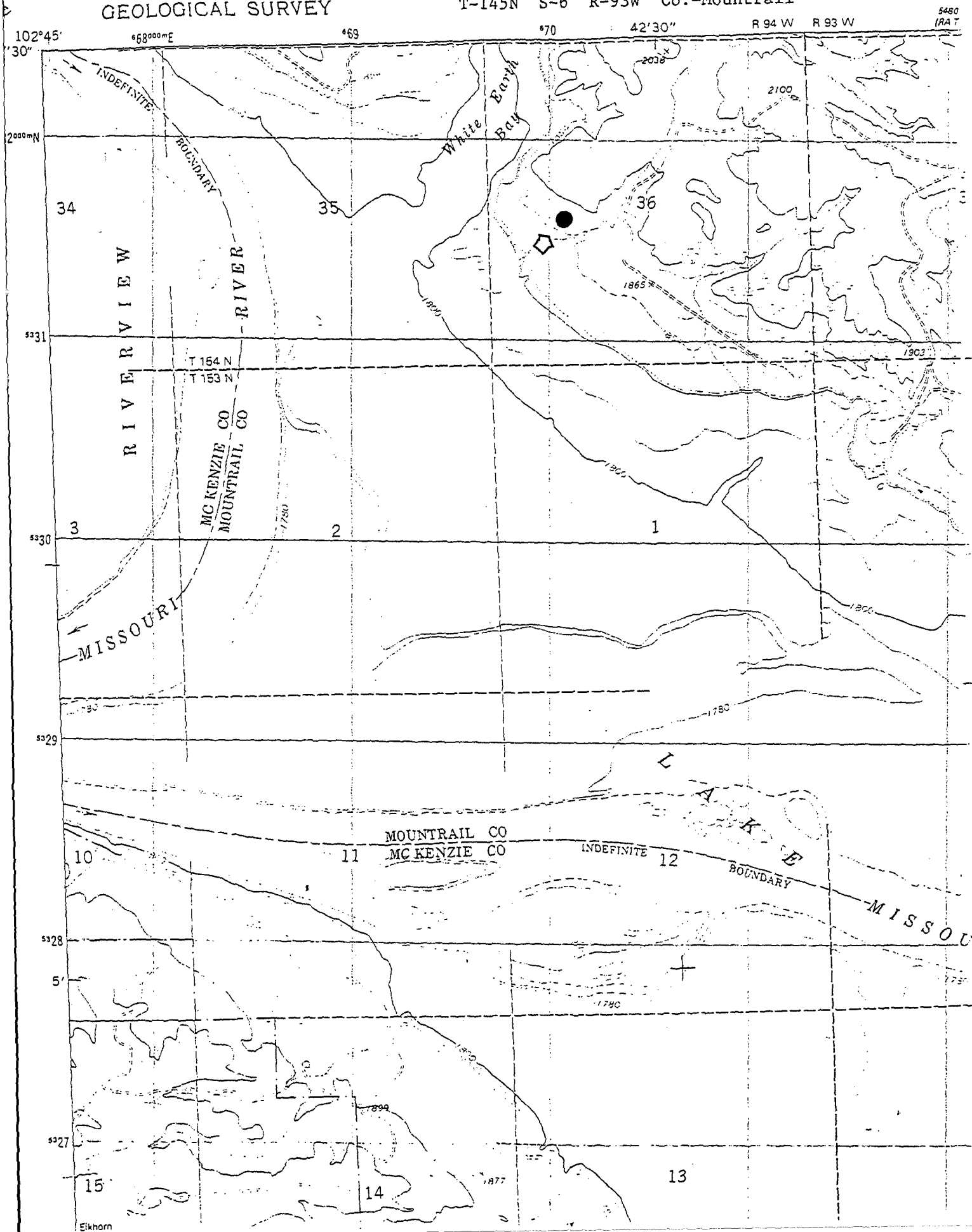


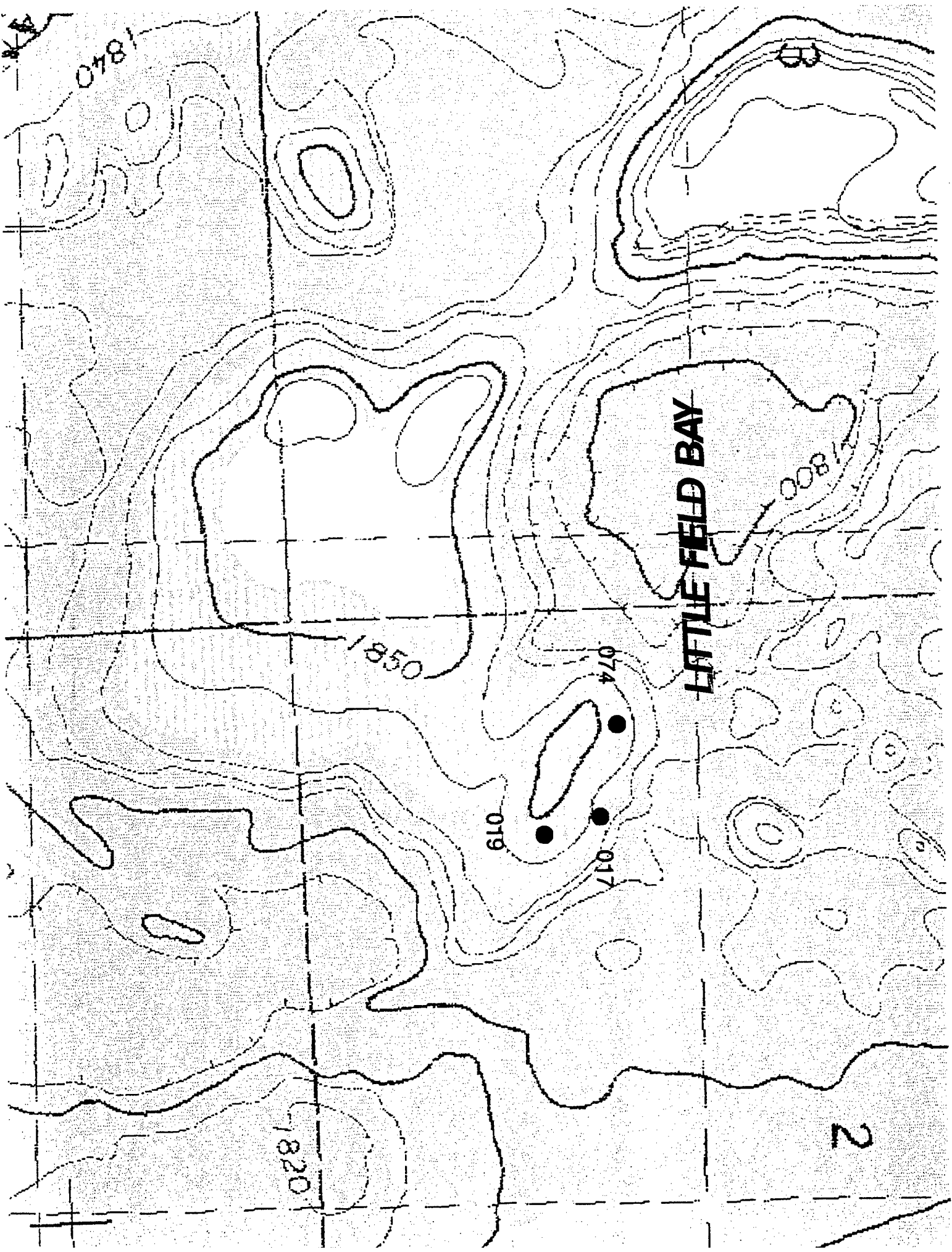
Mapped, edited, and published by the Geological Survey
 Control by USGS and NOS/NOAA
 Topography by photogrammetric methods from aerial photographs taken 1973 and 1977. Field checked 1975. Map edited 1981
 Underwater contours in Lake Sakakawea from USCE maps dated 1943
 Projection and 10,000-foot grid ticks: North Dakota coordinate system, north zone (Lambert conformal conic)
 1000-meter Universal Transverse Mercator grid, zone 13
 1927 North American Datum
 To place on the predicted North American Datum 1983 move the projection lines 3 meters north and 36 meters east as shown by dashed corner ticks
 There may be private inholdings within the boundaries of

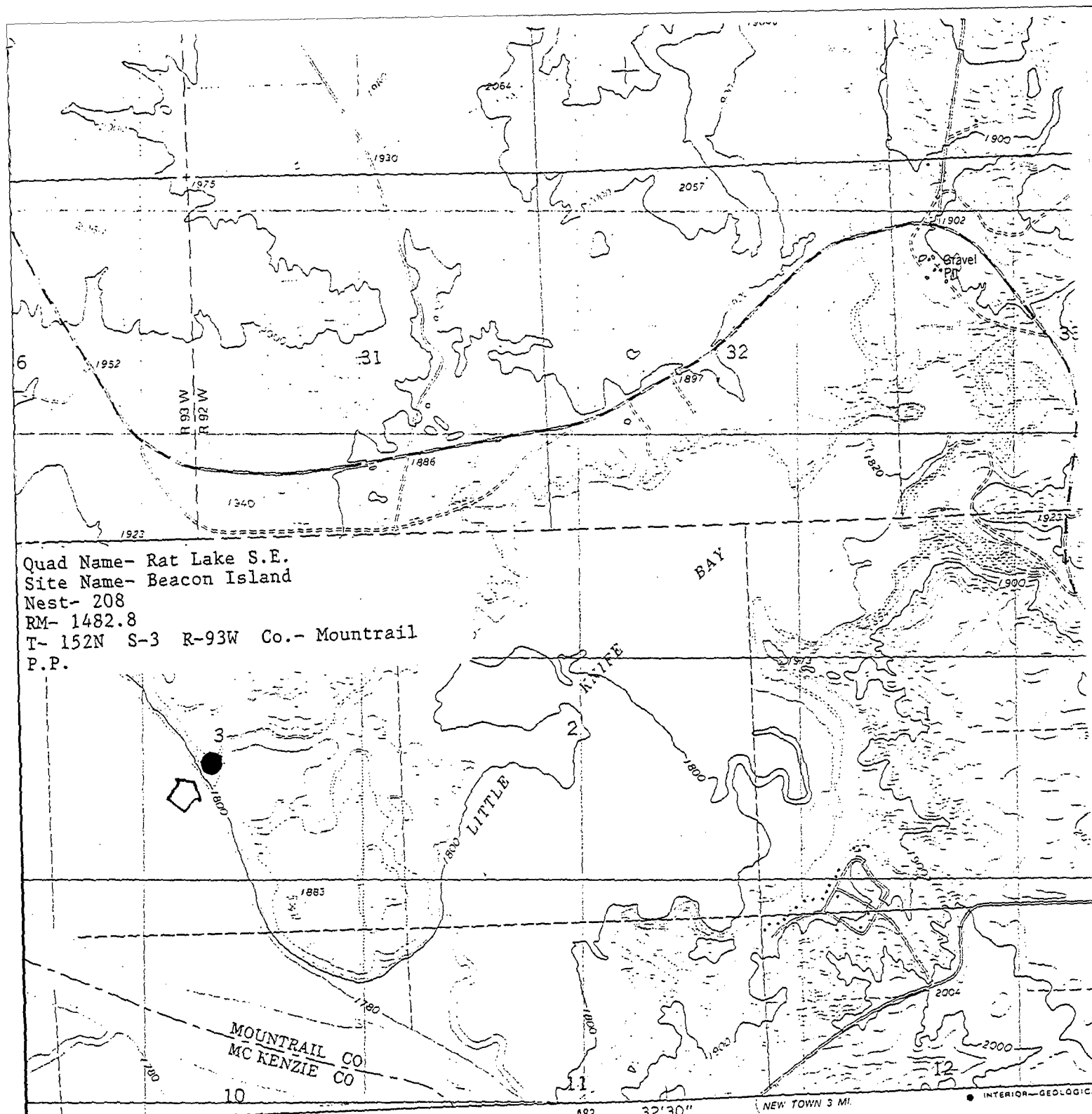
THIS MAP COMPLIES WITH
 FOR SALE BY U.S. GEOLOGICAL SURVEY, DE
 AND BY THE STATE WATER COMI
 A FOLDER DESCRIBING TOPOGRAPHIC A

UTM GRID AND 1981 MAGNETIC NORTH
 DECLINATION AT CENTER OF SHEET
 1°49' 32" MILS
 12° 213 MILS

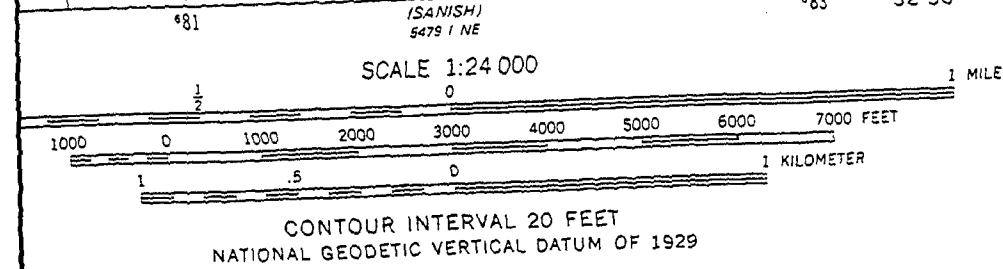
Quad Name-Rat Lake SW
Site Name-White Earth
Nest #- 205
RM- 1493.3
P.P.
T-145N S-6 R-93W Co.-Mountrail



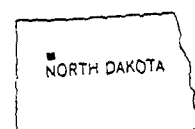




Quad Name- Rat Lake S.E.
 Site Name- Beacon Island
 Nest- 208
 RM- 1482.8
 T- 152N S-3 R-93W Co.- Mountrail
 P.P.



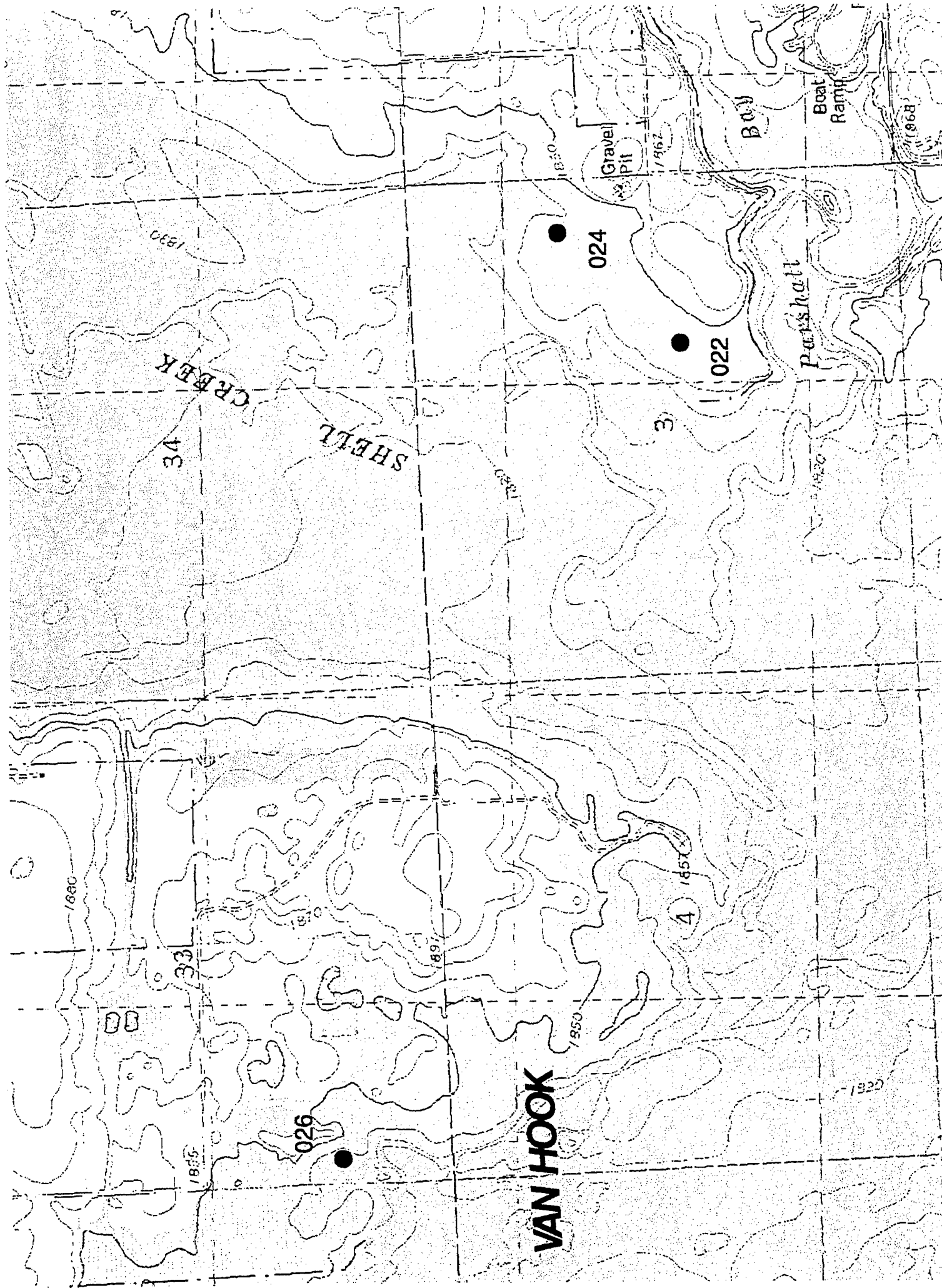
Primary highway,
 hard surface
 Secondary highway,
 hard surface
 Interstate Route

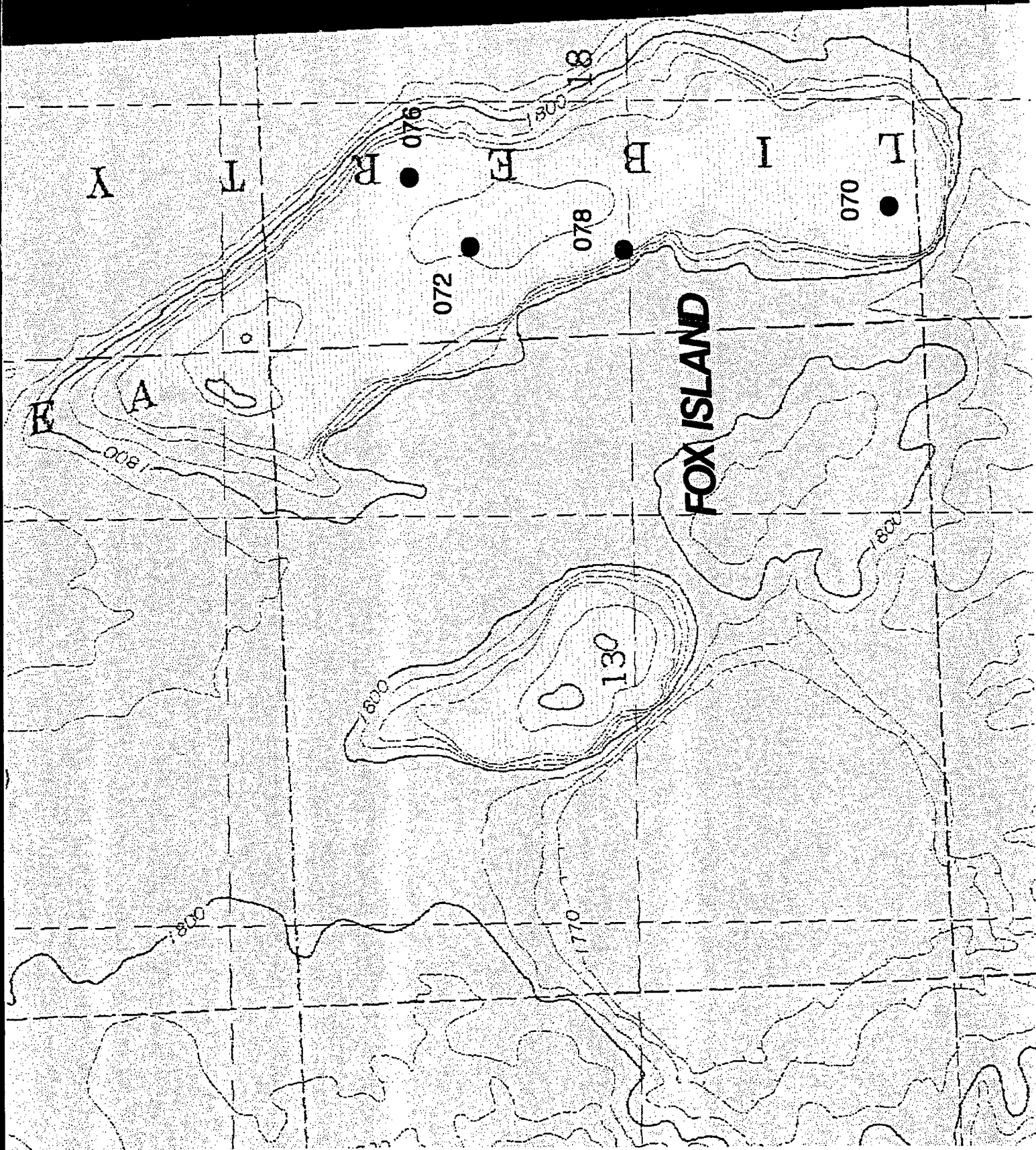


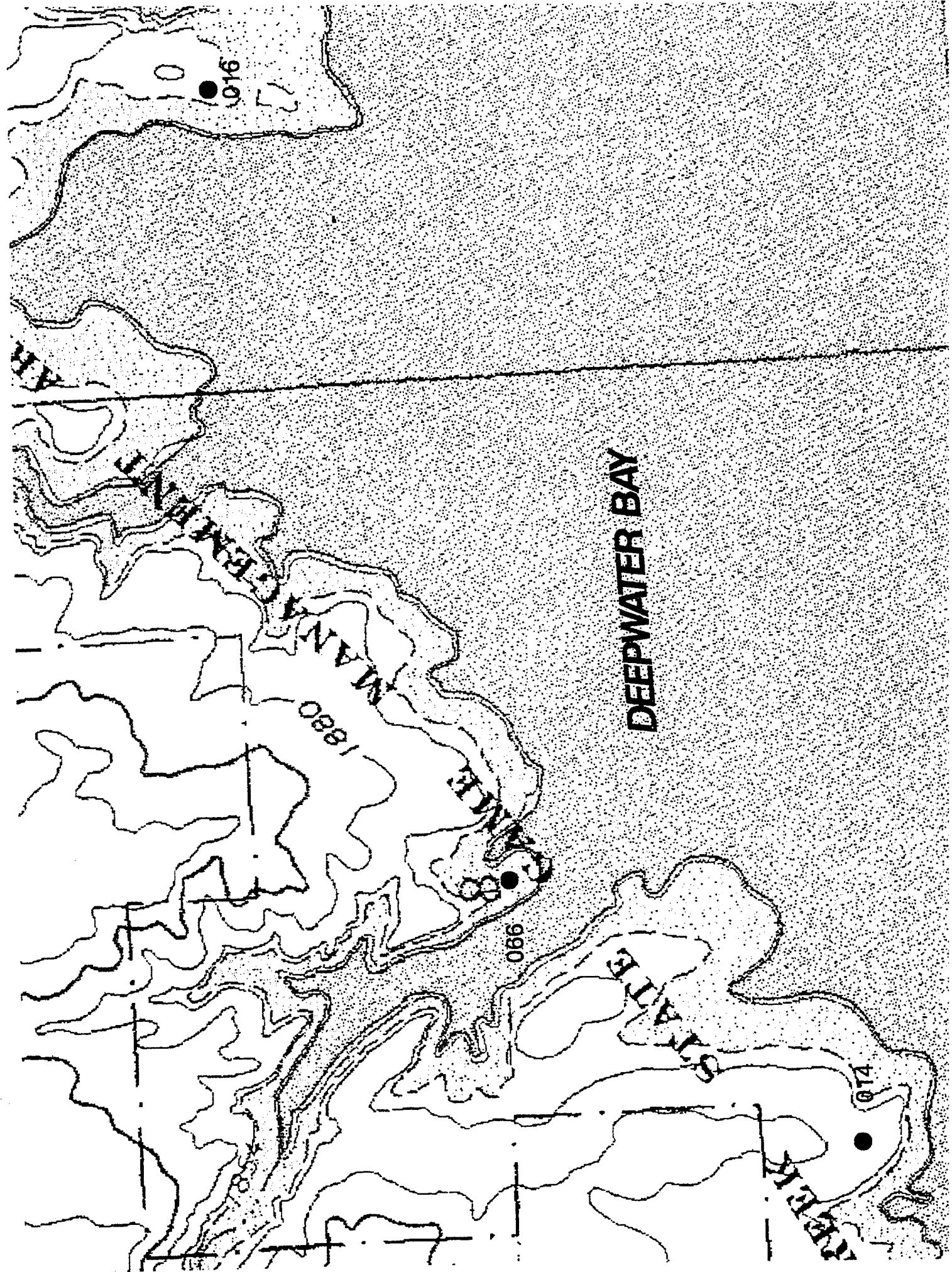
QUADRANGLE LOCATION
 Areas covered by dashed light-blue pattern
 are subject to controlled inundation

R/

THIS MAP COMPLIES WITH NATIONAL MAP ACCURACY STANDARDS
 BY U.S. GEOLOGICAL SURVEY, DENVER, COLORADO 80225, OR RESTON, VIRGINIA 22092
 AND BY THE STATE WATER COMMISSION, BISMARCK, NORTH DAKOTA 58501
 A FOLDER DESCRIBING TOPOGRAPHIC MAPS AND SYMBOLS IS AVAILABLE ON REQUEST







DEEPWATER BAY

1880

0881

066

016

014

MANA

ETNA

SLATE

TERRA

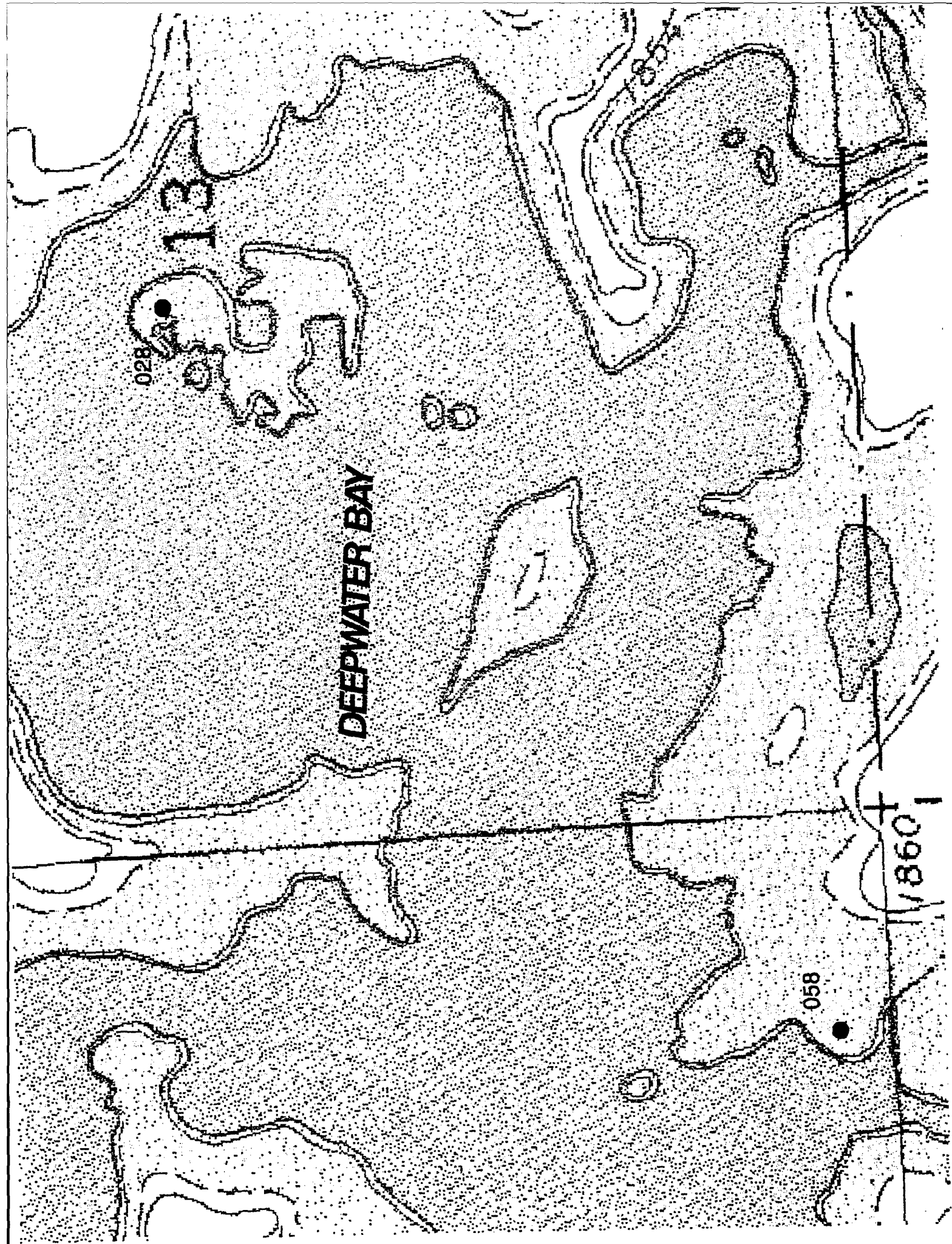
028

13

DEEPWATER BAY

058

1860



INDEPENDANCE PT

33

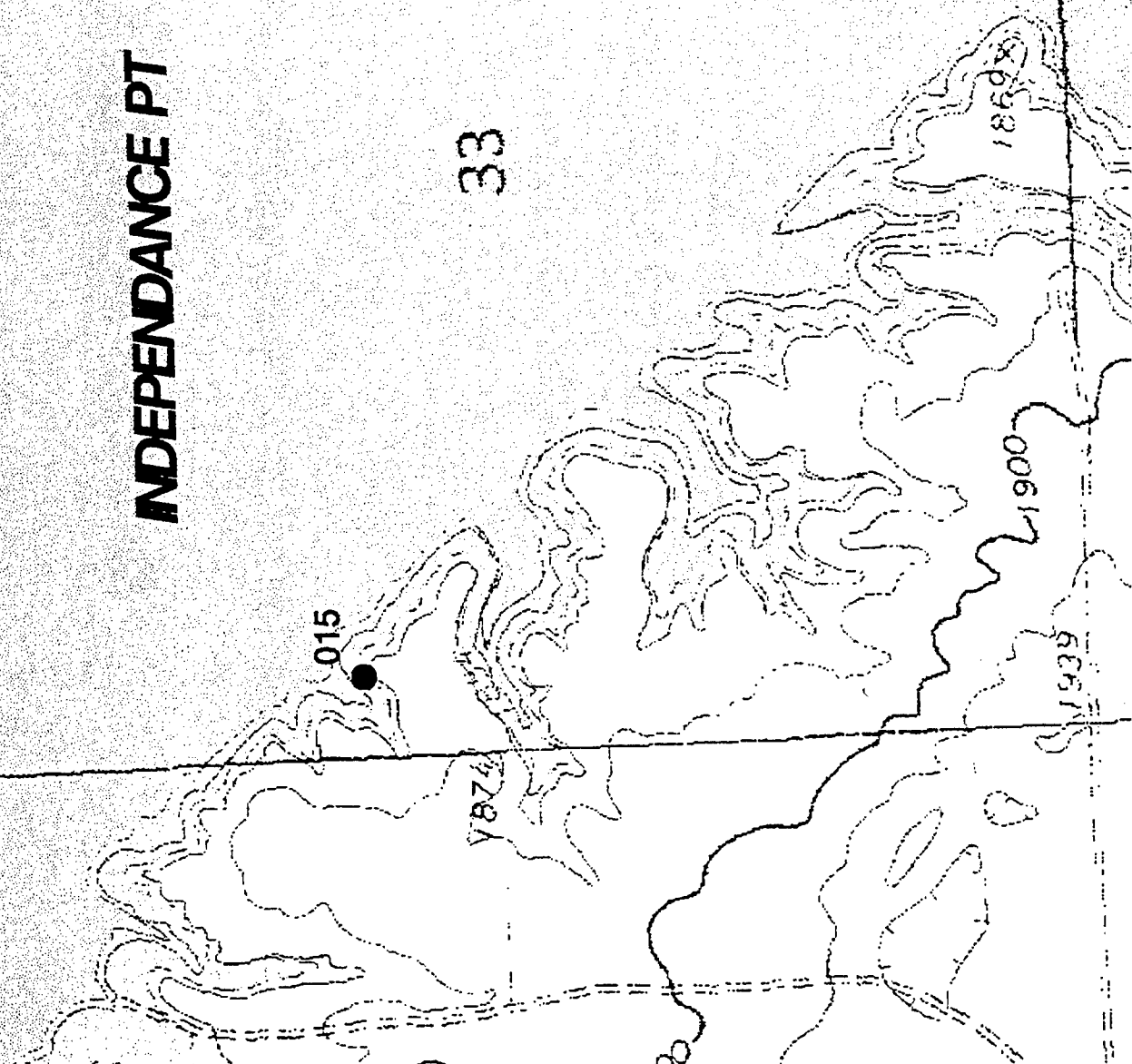
015

1874

1860

1900

1939

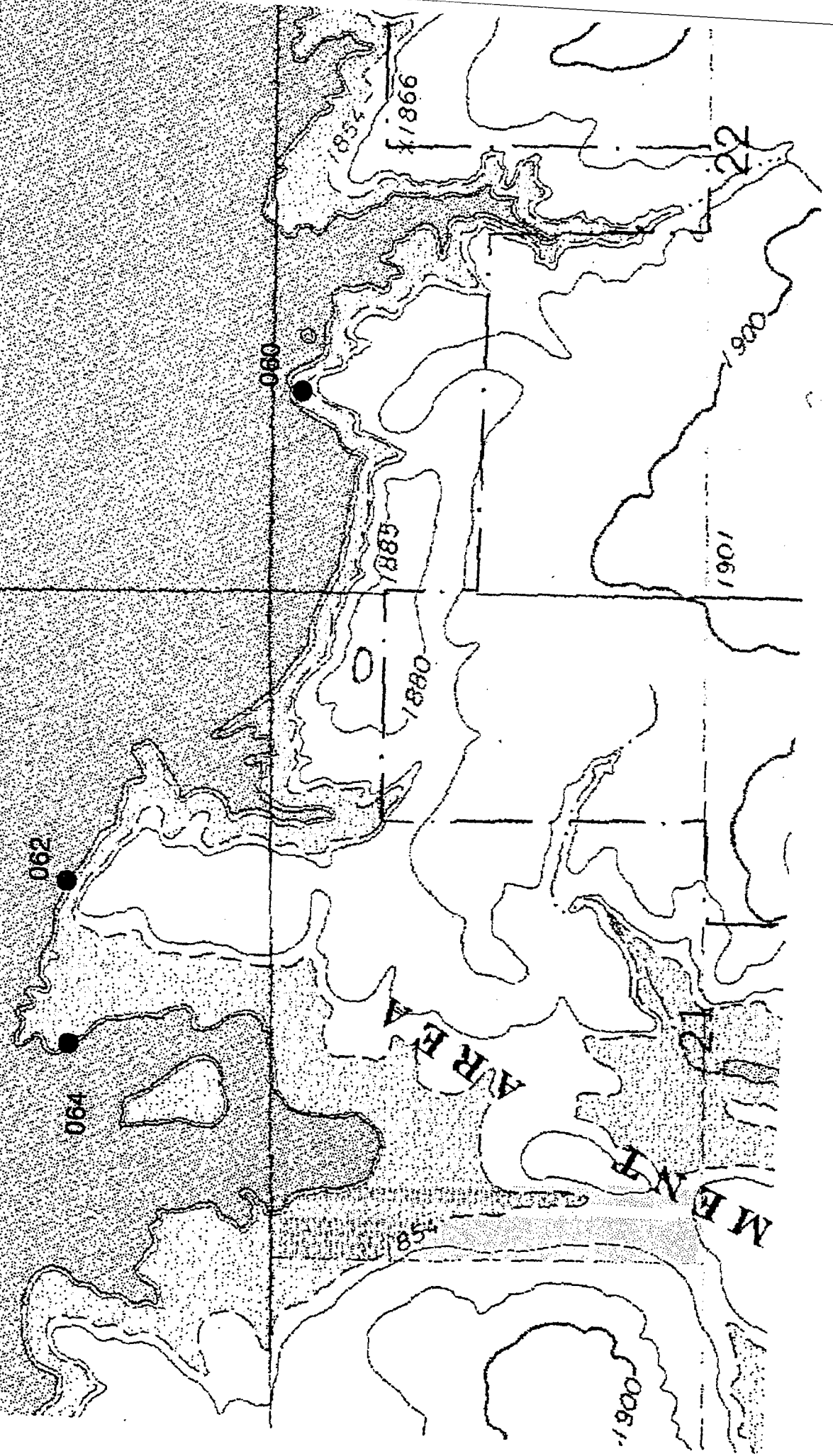


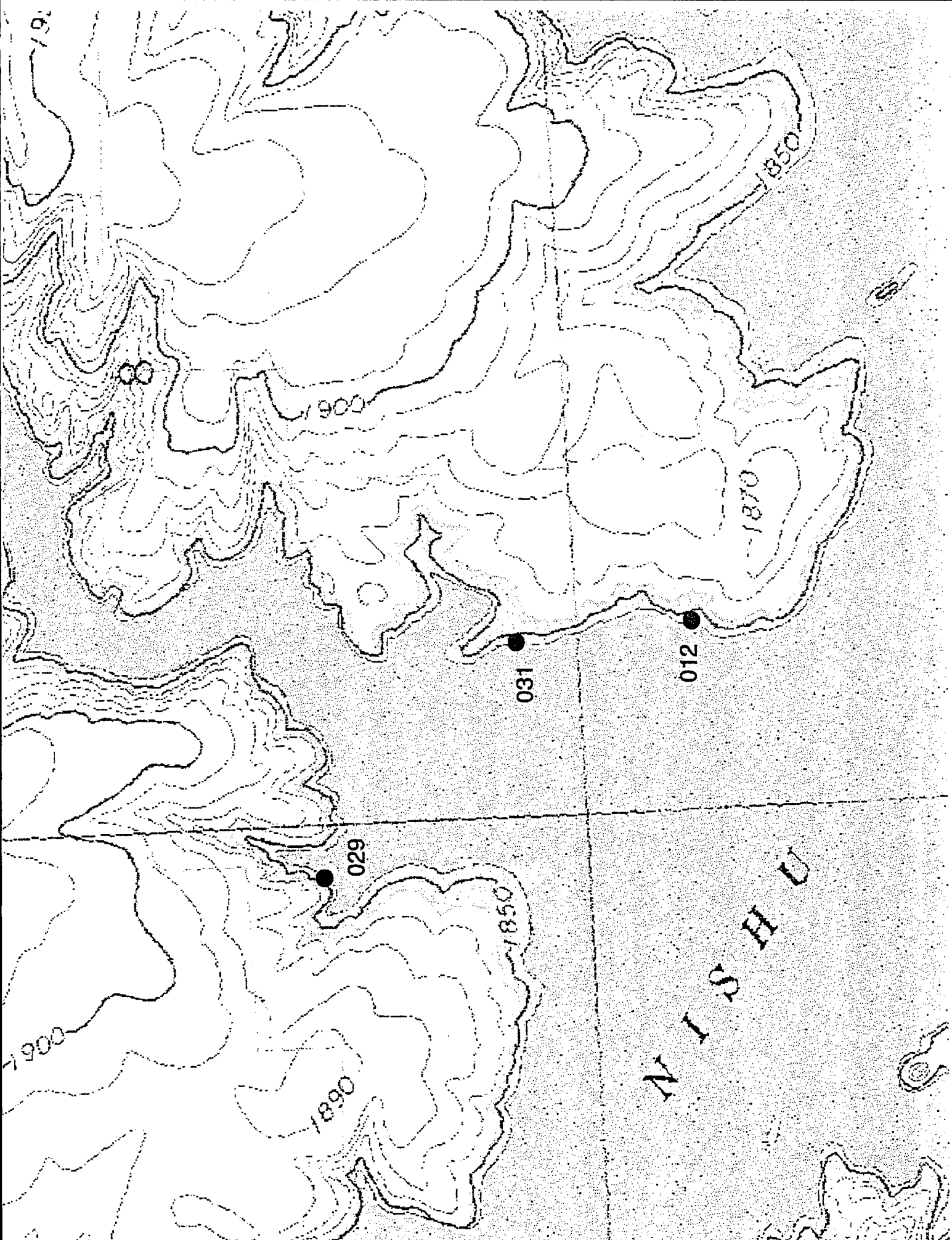
DEEP WATER

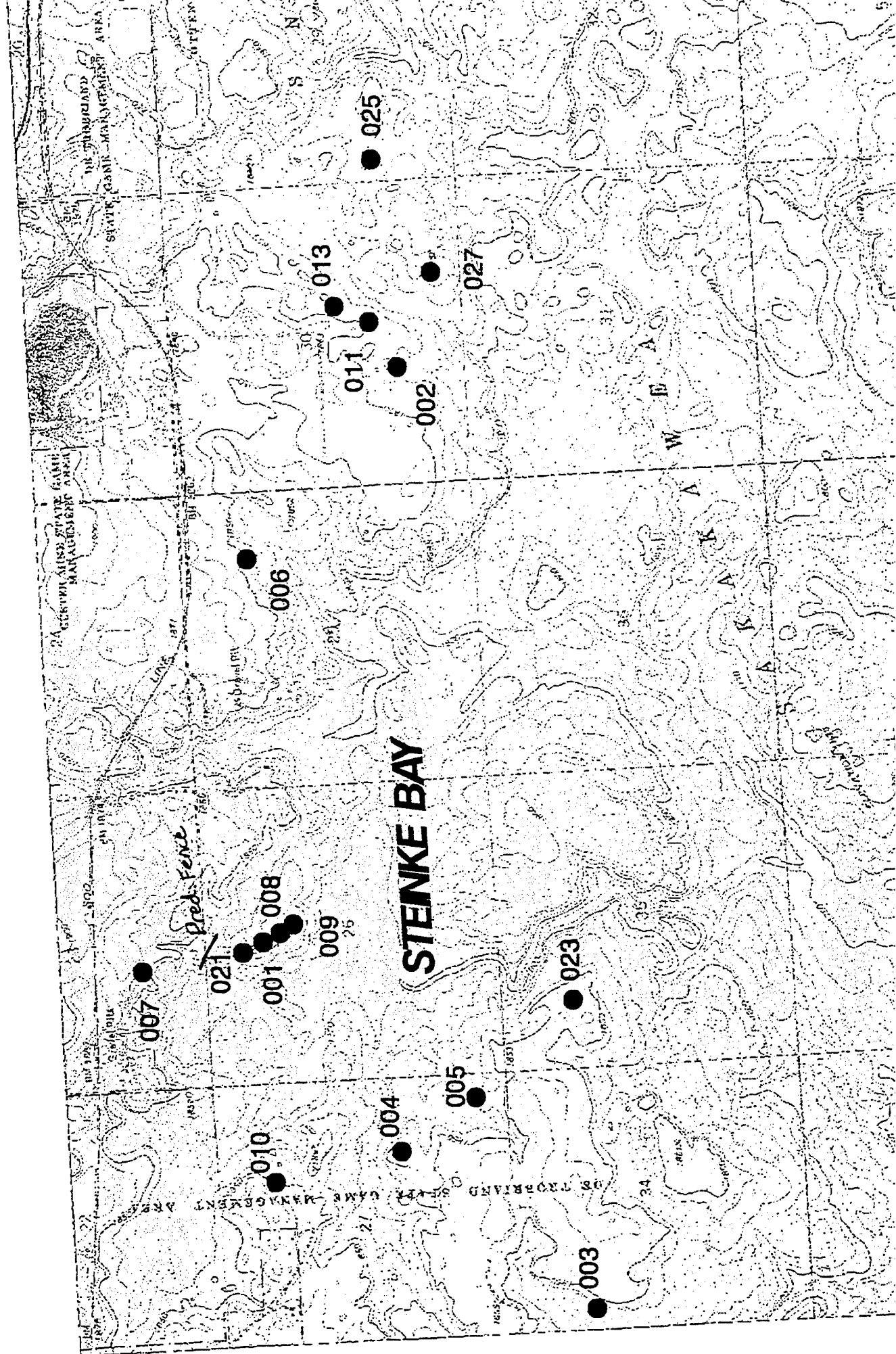
16

CREEK

15







STENKE BAY

STATE GAME MANAGEMENT AREA

STATE GAME MANAGEMENT AREA

STATE GAME MANAGEMENT AREA

007

021

008

001

009

010

004

005

003

006

011

013

025

027

023

Pred. Fence

002

001

009

010

004

005

003

006

011

013

025

027

023

002

001

009

010

004

005

003

006

011

013

025

027

023

002

001

009

010

004

005

003

006

011

013

025

027

023

002

001

009

010

004

005

003

006

011

013

025

027

023

002

001

009

010

004

005

003

006

011

013

025

027

023

002

001

009

010

004

005

003

006

011

013

025

027

023

002

001

009

010

004

005

003

006

011

013

025

027

023

002

001

009

010

004

005

003

006

011

013

025

027

023

002

001

009

010

004

005

003

006

011

013

025

027

023

002

001

009

010

004

005

003

006

011

013

025

027

023

002

001

009

010

004

005

003

006

011

013

025

027

023

002

001

009

010

004

005

003

006

011

013

025

027

023

002

001

009

010

004

005

003

006

011

013

025

027

023

002

001

009

010

004

005

003

006

011

013

025

027

023

002

001

009

010

004

005

003

006

011

013

025

027

023

002

001

009

010

004

005

003

006

011

013

025

027

023

002

001

009

010

004

005

003

006

011

013

025

027

023

002

001

009

010

004

005

003

006

011

013

025

027

023

002

001

009

010

004

005

003

006

011

013

025

027

023

002

001

009

010

004

005

003

006

011

013

025

027

023

002

001

009

010

004

005

003

006

011

013

025

027

023

002

001

009

010

004

005

003

006

011

013

025

027

023

002

001

009

010

004

005

003

006

011

013

025

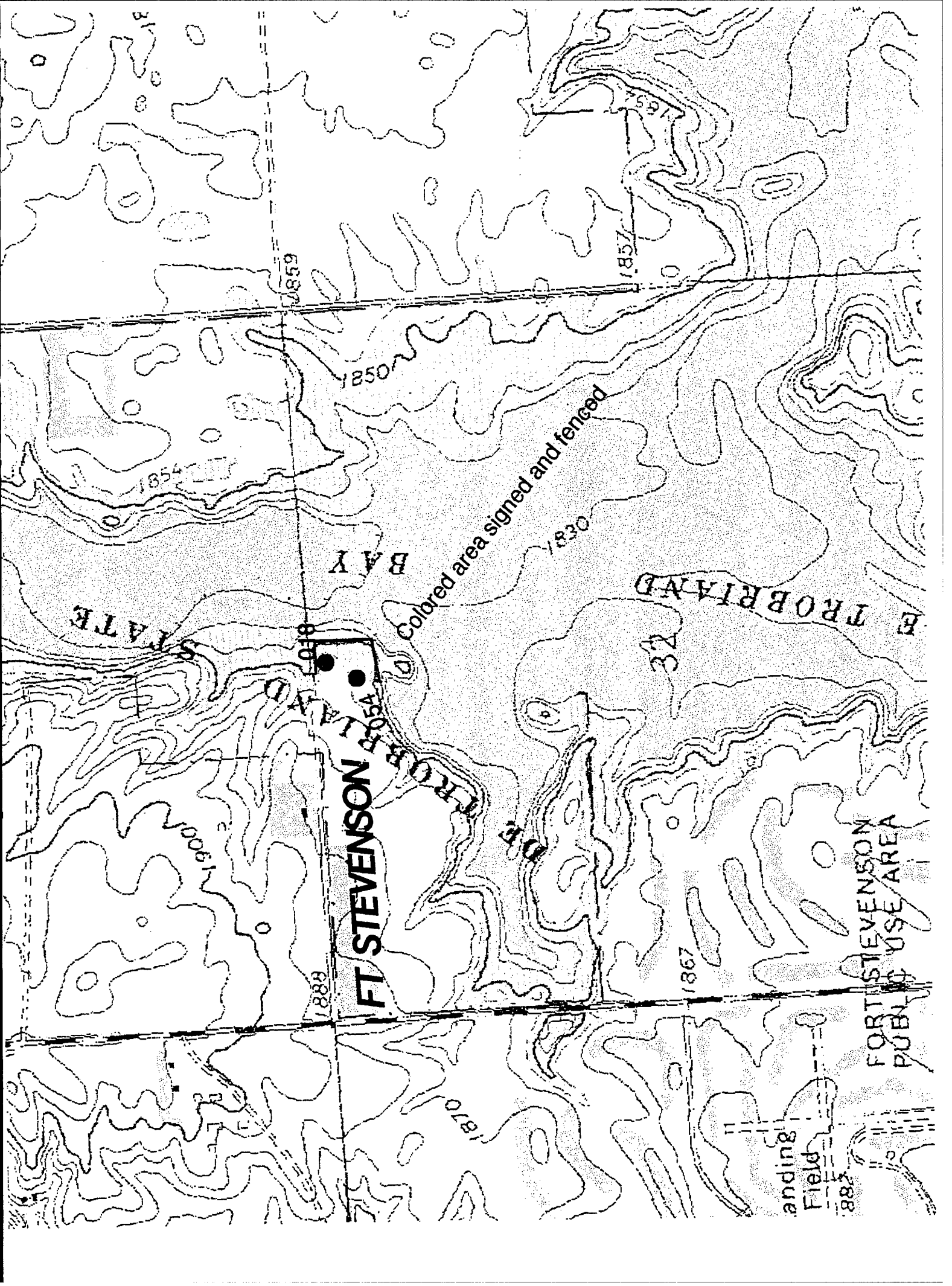
027

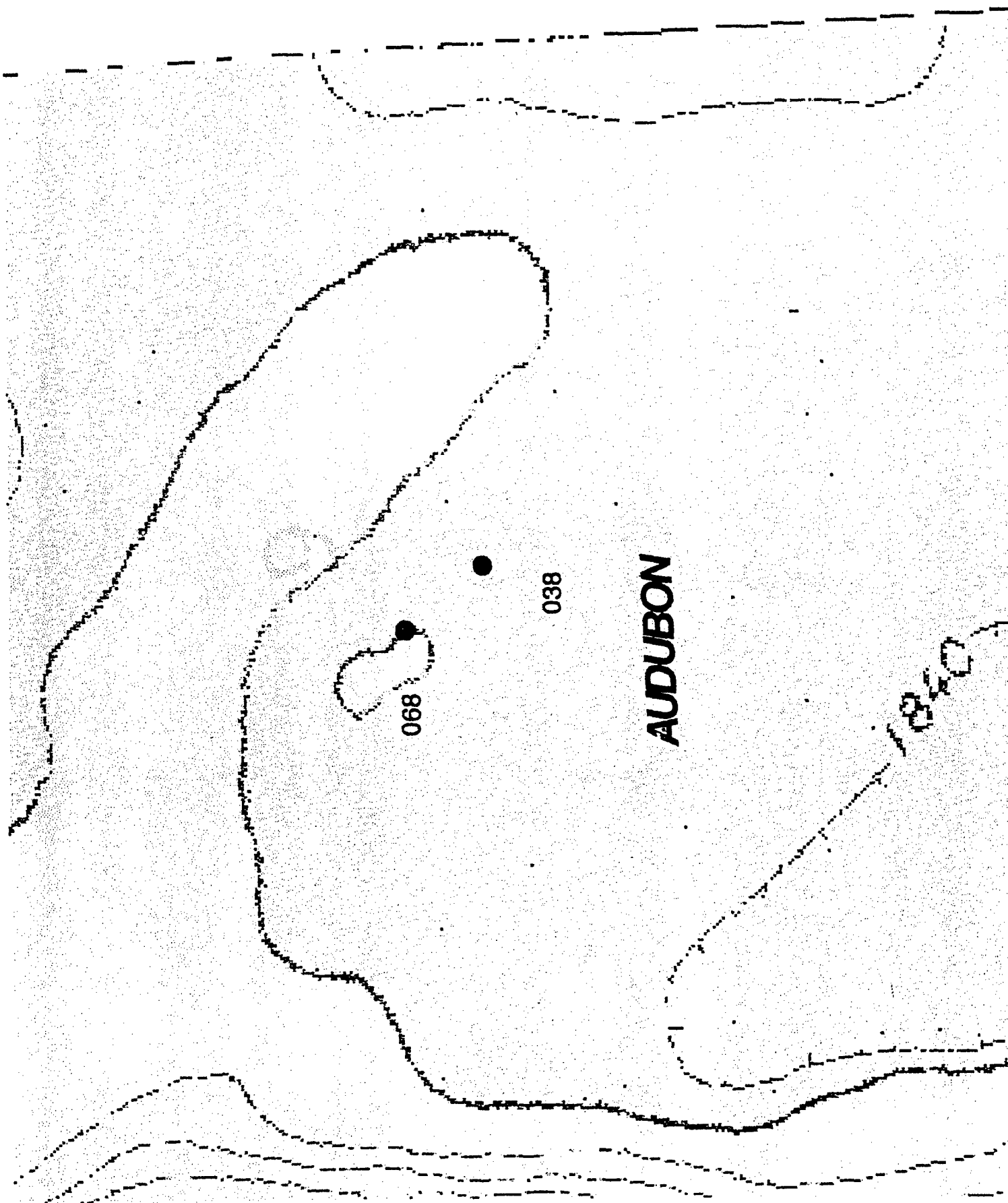
023

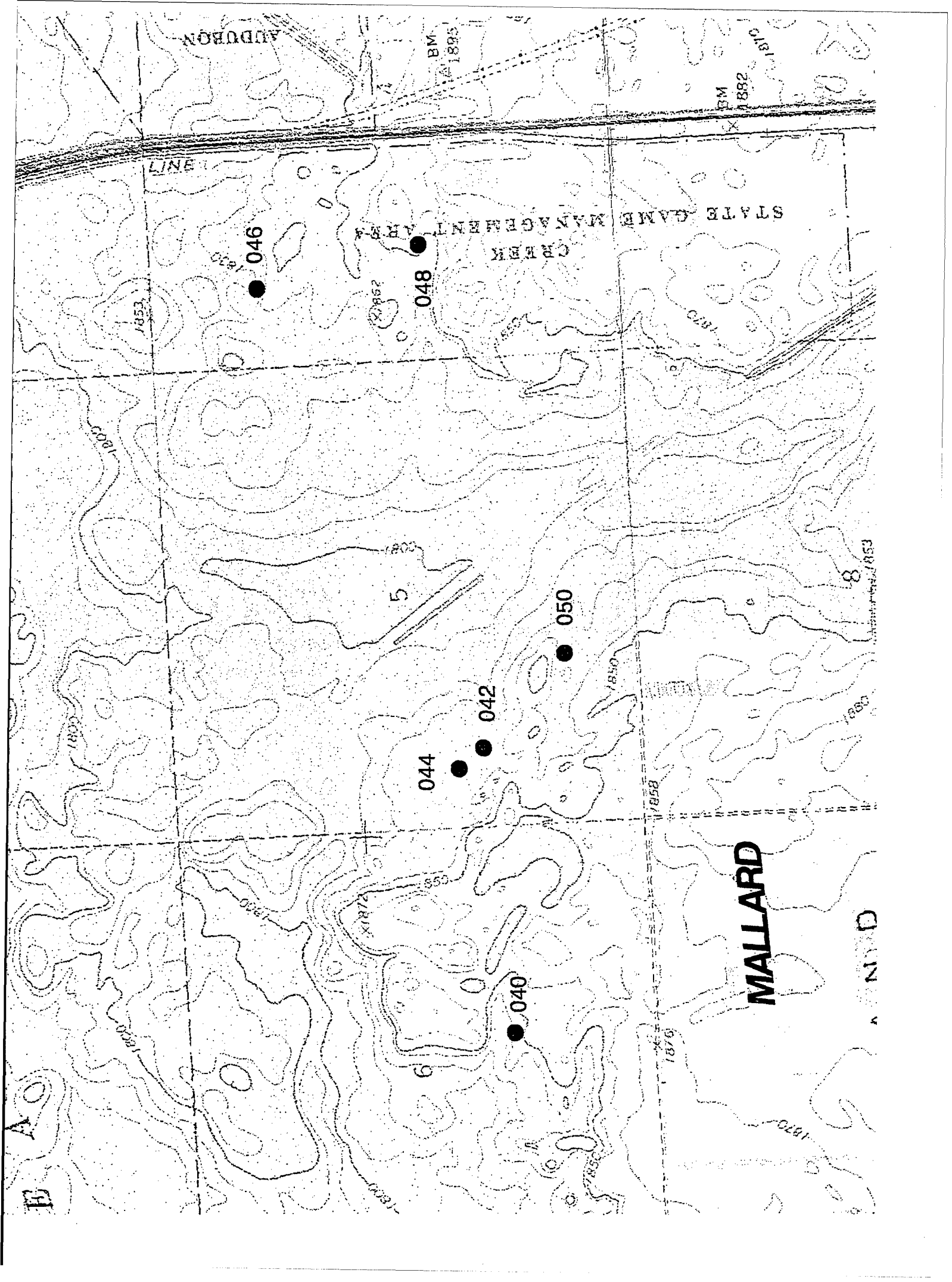
002

001

009

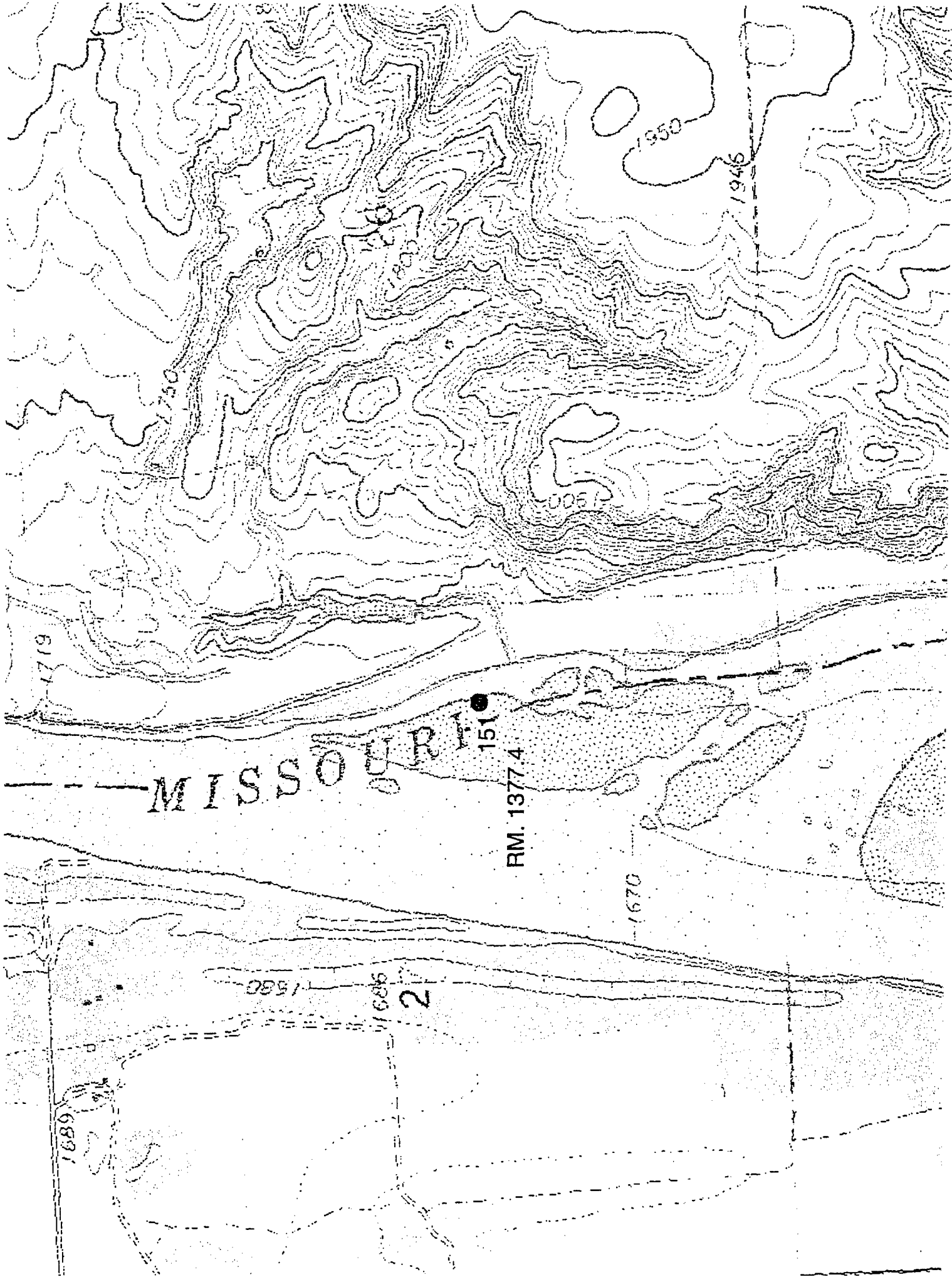






GARRISON RIVER





RM 1364.3

34

186,182,181

34

MISSOURI MCLEAN CO
OLIVER CO

33

32

Nelson Lake

BM 1751

BRIDGE

NORTHERN

BM 1710

BM 1715

4

5

1500

1600

1700

1800

1900

166, 169, 170,
167, 172, 171
● 168, 165, 164,
163, 178 VER

MISSOURI
RM 1362

MISSOURI
RM 1366

● 162

MISSOURI

RM 1358

183, 185, 190,
187, 188, 189,
177, 175, 179,
176, 180.


LEWIS AND CLARK
GAME MANAGEMENT
AREA

BM

1571

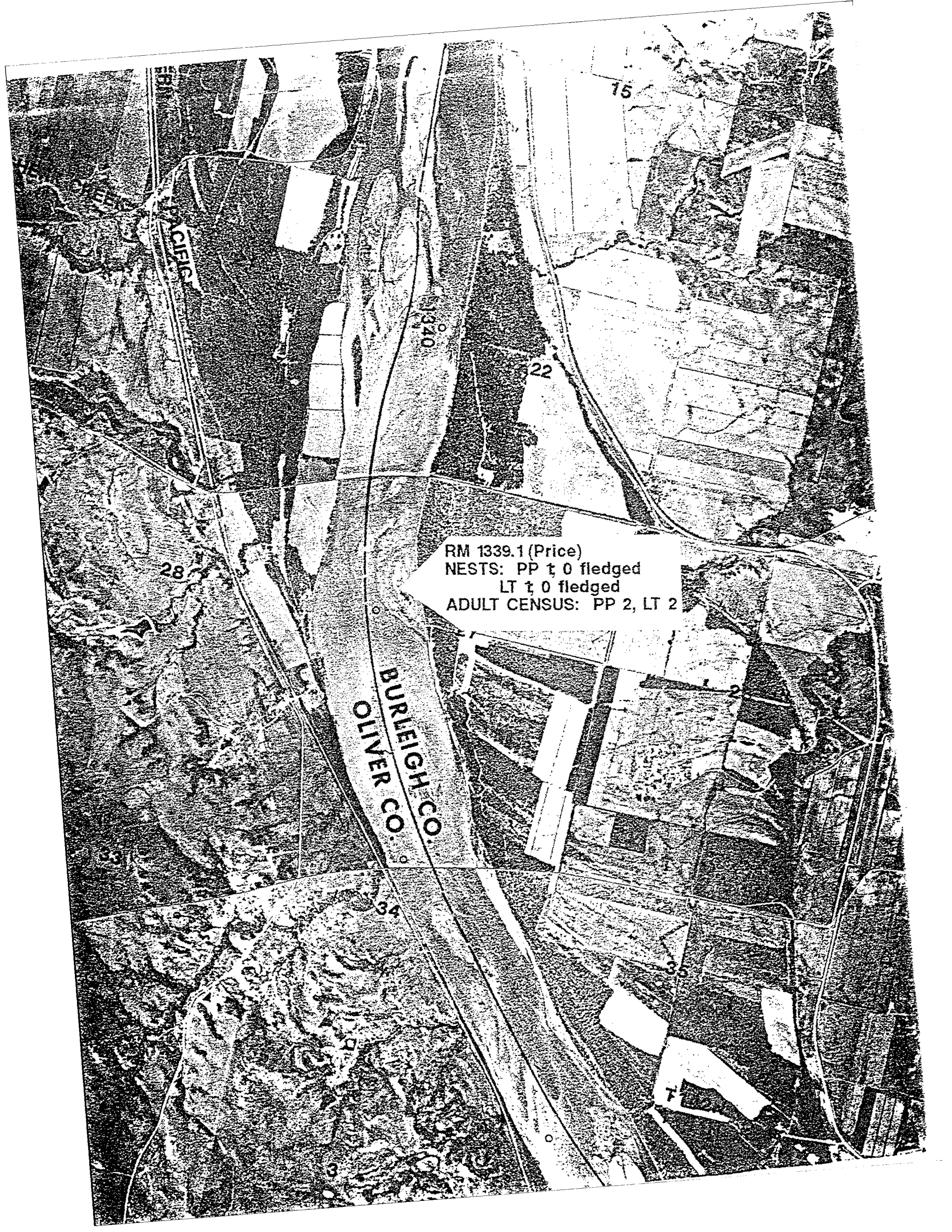
1670

166

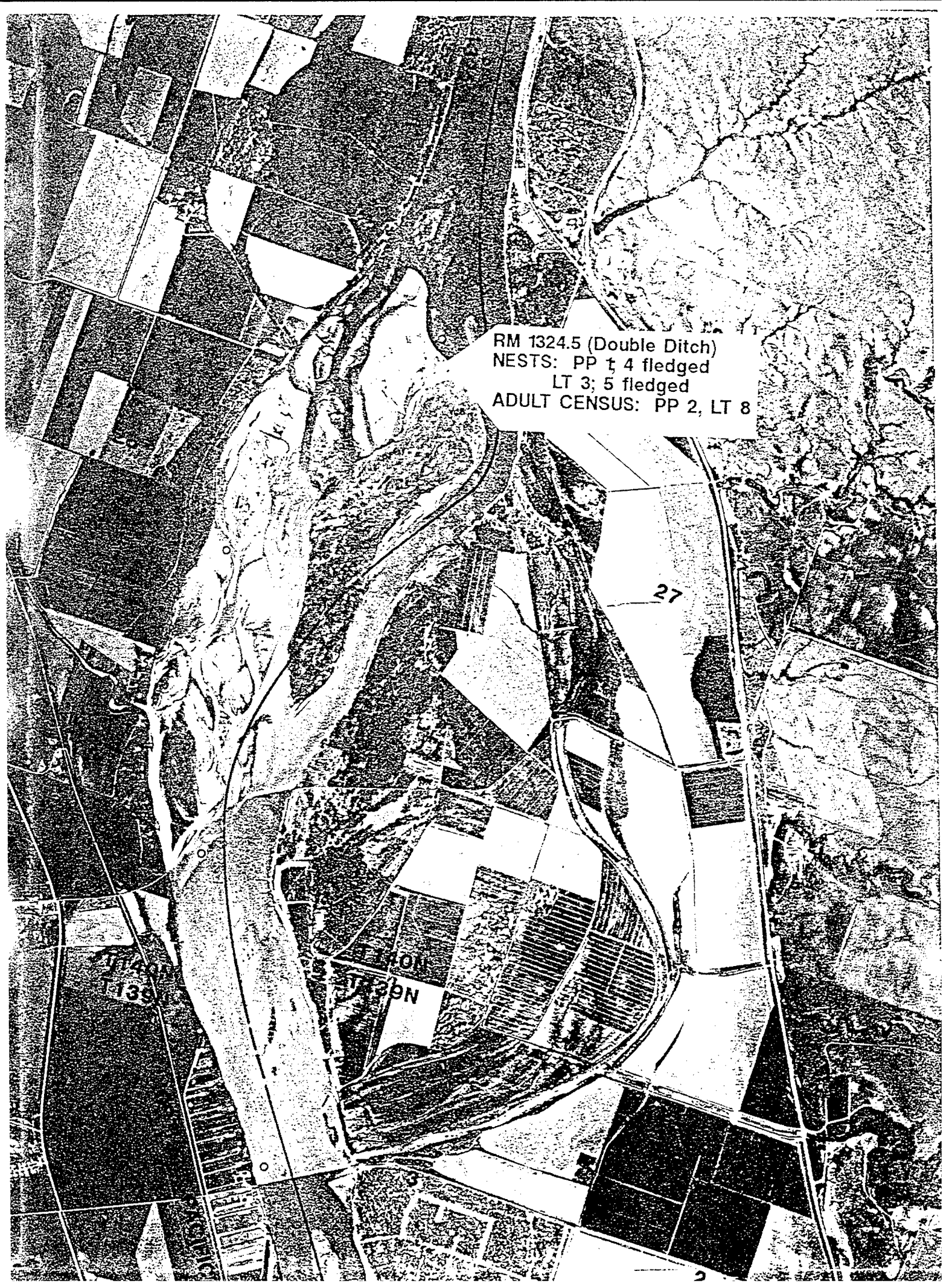


RM 1349.7 (Painted Woods Island)
NESTS: PP 3; 9 fledged
LT 6; 7 fledged
ADULT CENSUS: PP 7, LT 12

RM 1347.4 (Cross Ranch)
NESTS: PP 1; 0 fledged
LT 3; 4 fledged
ADULT CENSUS: PP 5, LT 6



RM 1339.1 (Price)
NESTS: PP \pm 0 fledged
LT \pm 0 fledged
ADULT CENSUS: PP 2, LT 2



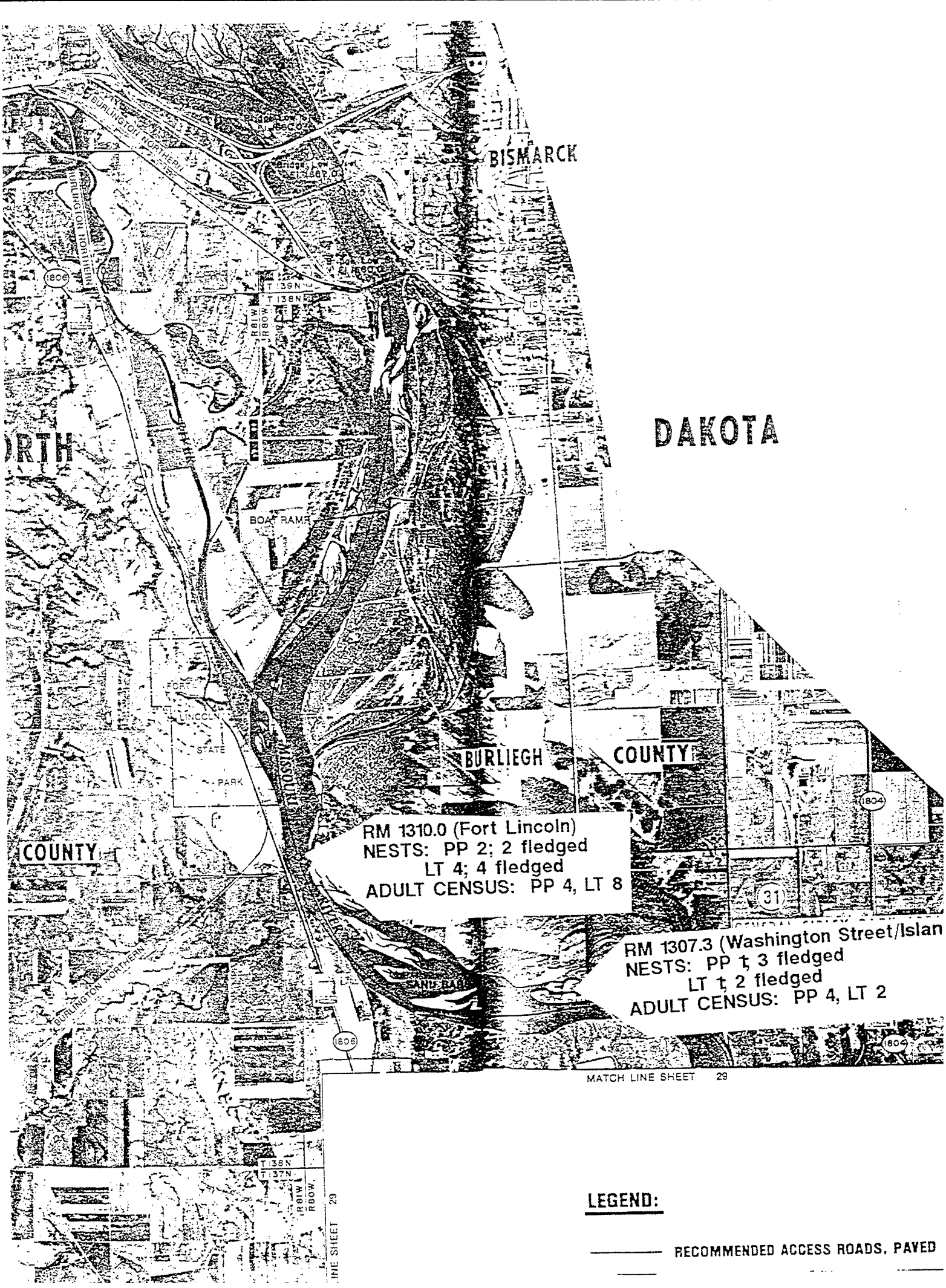
RM 1324.5 (Double Ditch)
NESTS: PP 4; 4 fledged
LT 3; 5 fledged
ADULT CENSUS: PP 2, LT 8

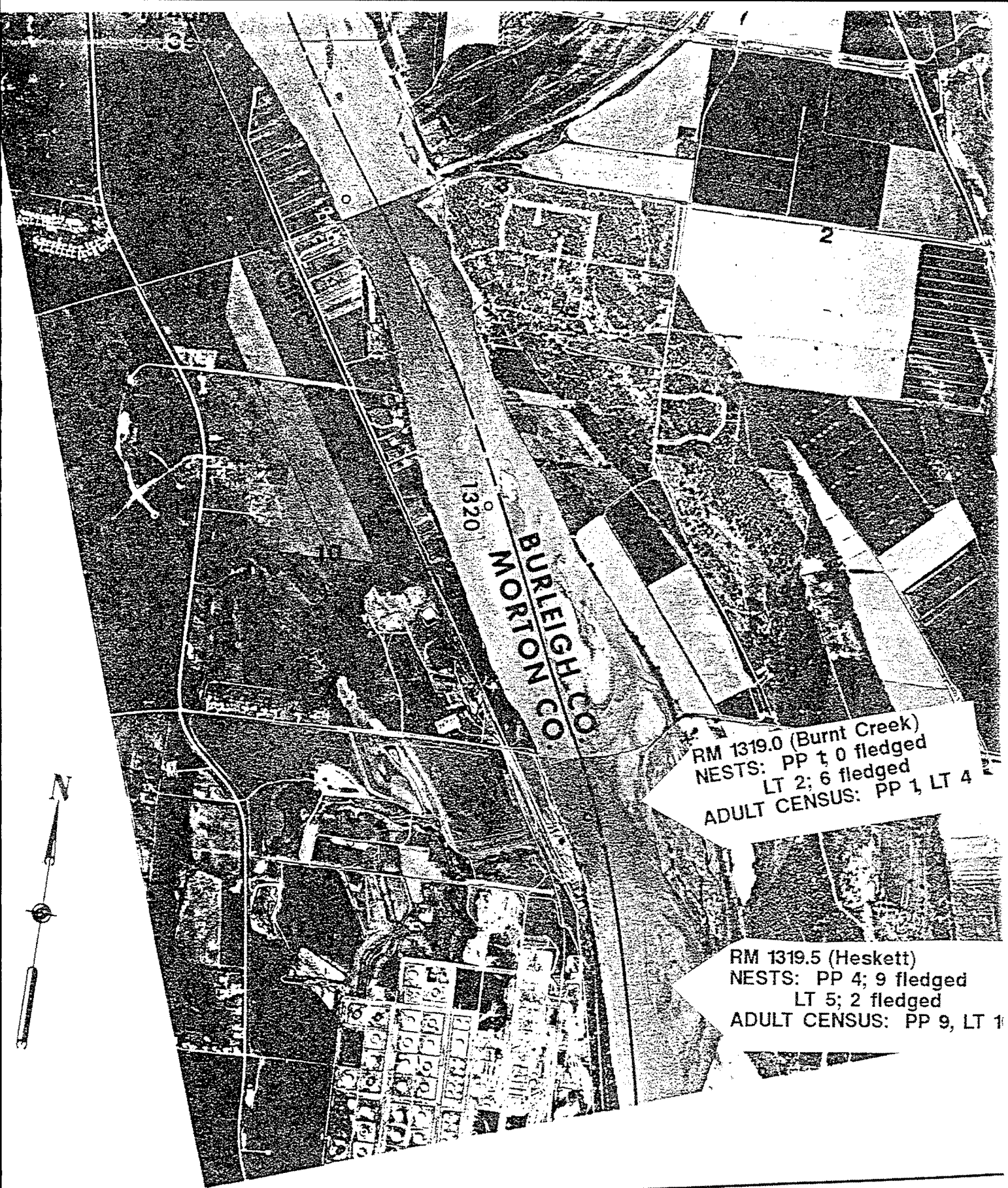
27

1140N
1139N

1140N
1139N



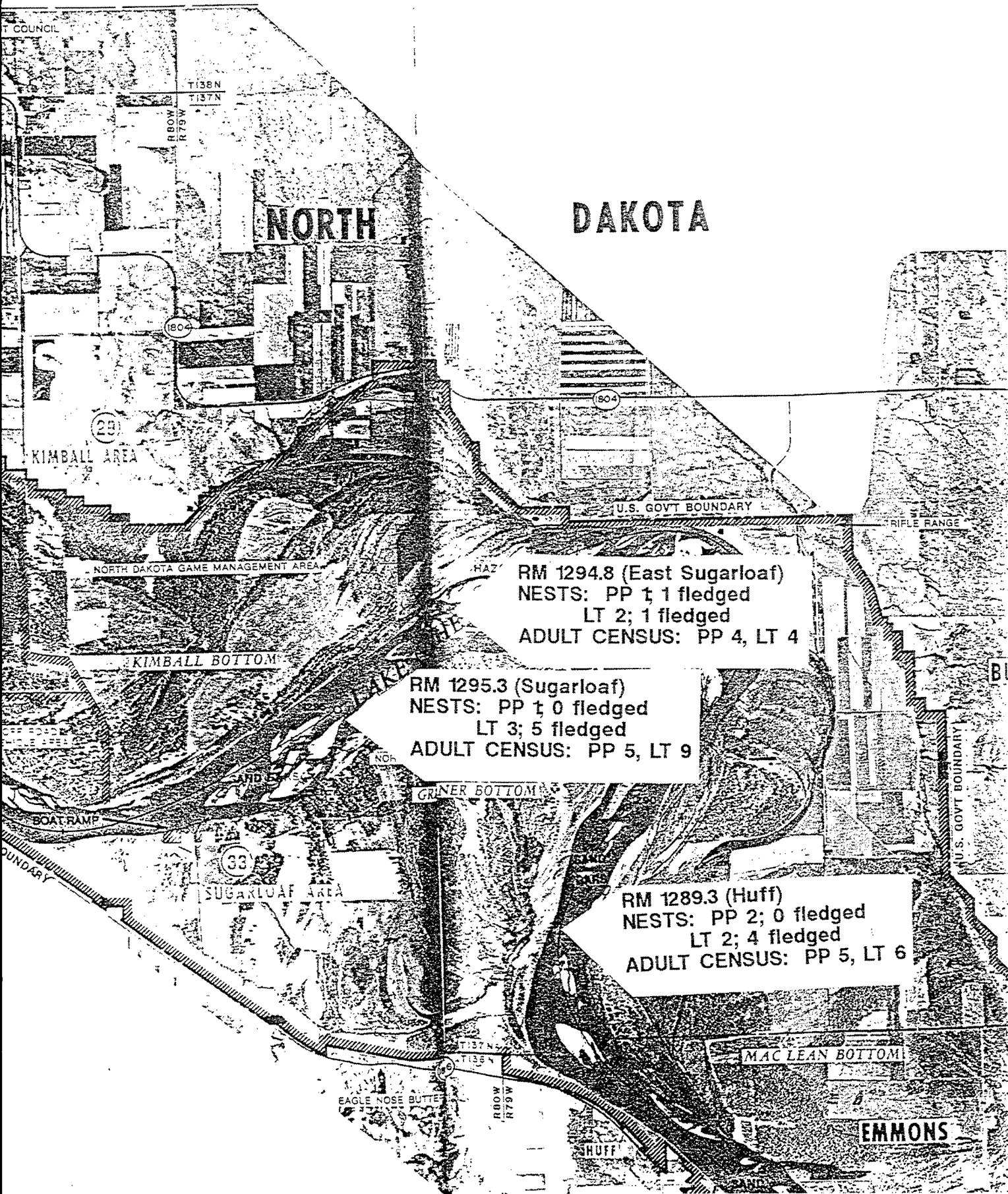




RM 1319.0 (Burnt Creek)
NESTS: PP 1, 0 fledged
LT 2; 6 fledged
ADULT CENSUS: PP 1, LT 4

RM 1319.5 (Heskett)
NESTS: PP 4; 9 fledged
LT 5; 2 fledged
ADULT CENSUS: PP 9, LT 1

LAKE OAHE



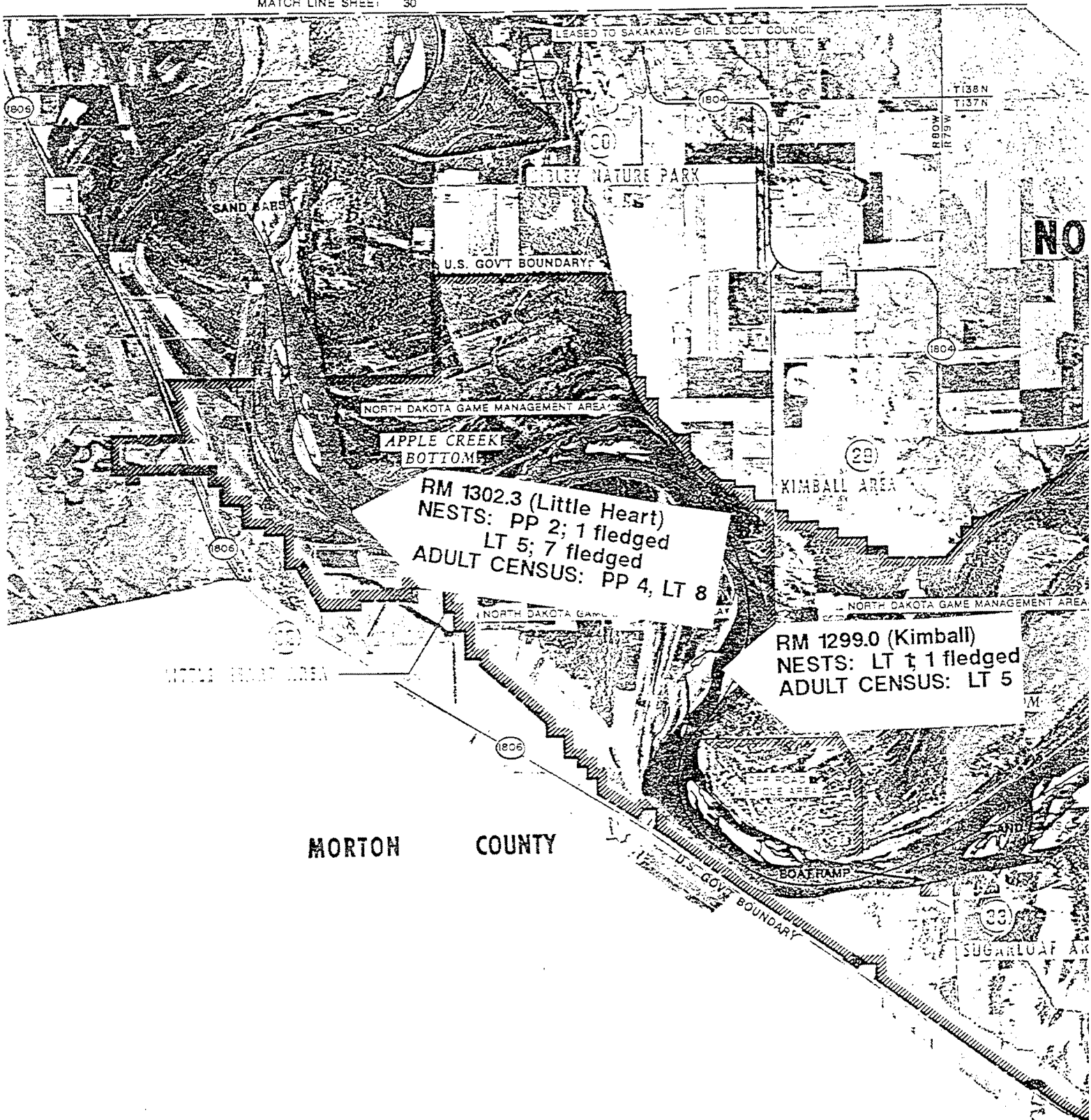
NORTH

DAKOTA

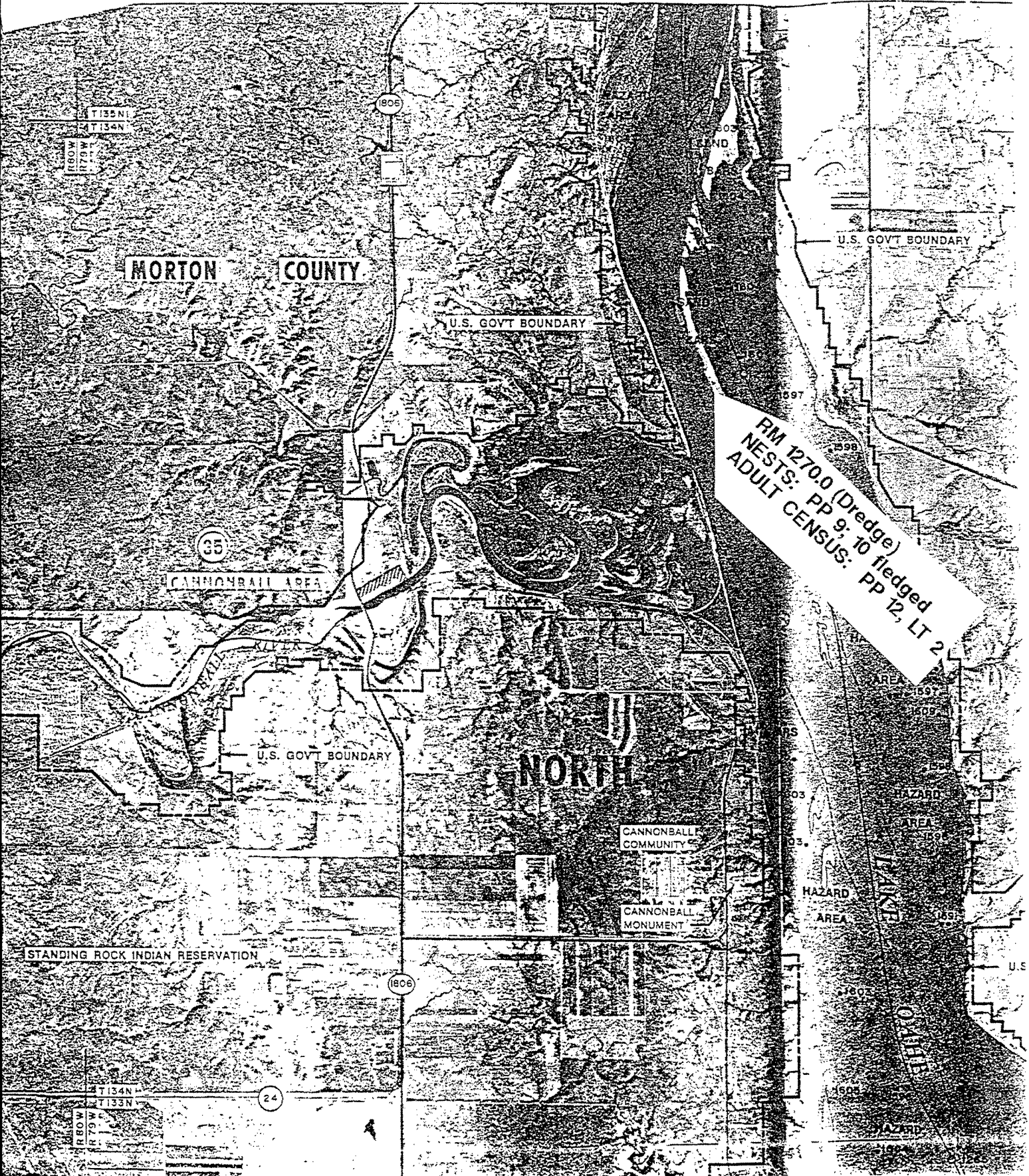
RM 1294.8 (East Sugarloaf)
NESTS: PP 1; 1 fledged
LT 2; 1 fledged
ADULT CENSUS: PP 4, LT 4

RM 1295.3 (Sugarloaf)
NESTS: PP 1; 0 fledged
LT 3; 5 fledged
ADULT CENSUS: PP 5, LT 9

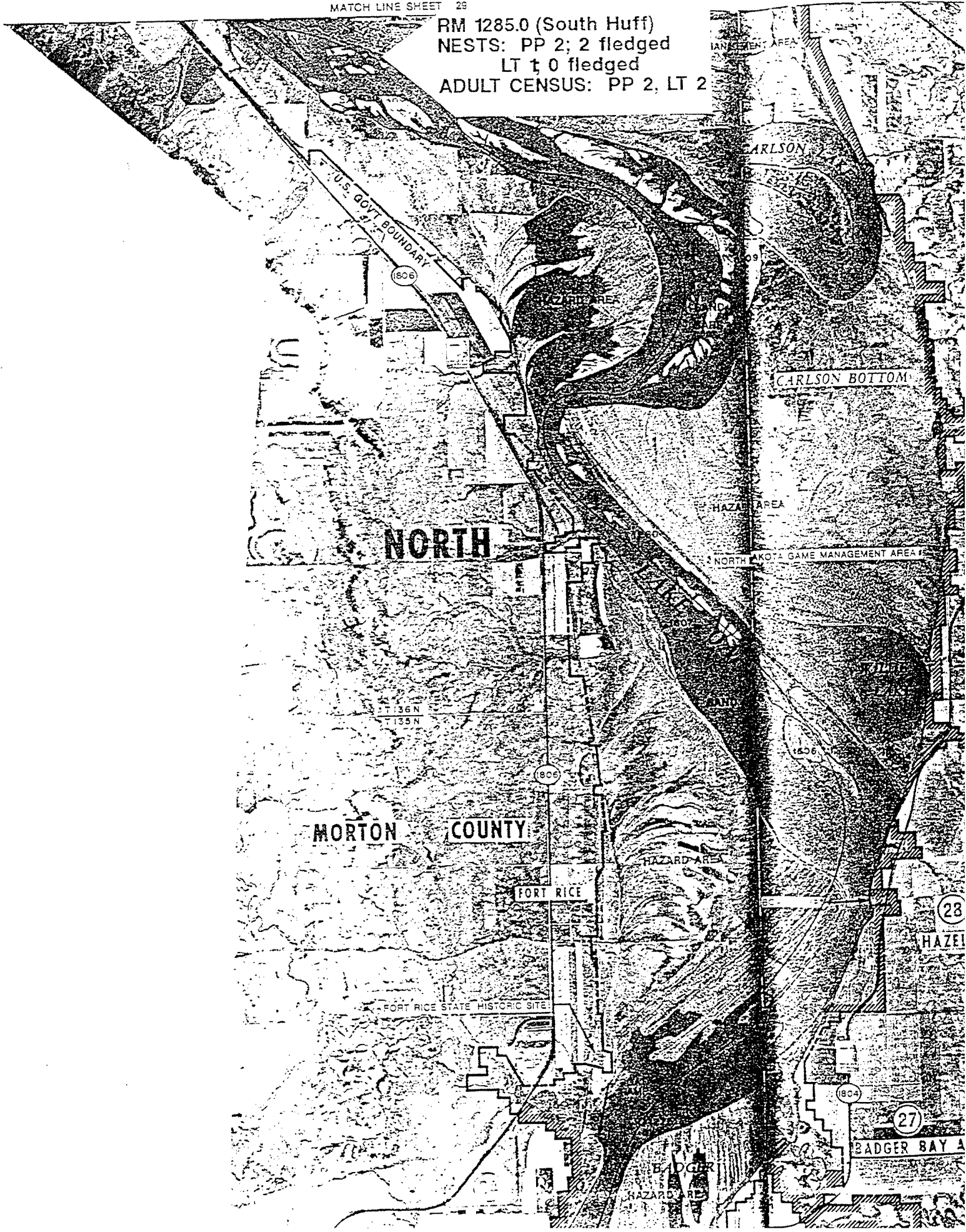
RM 1289.3 (Huff)
NESTS: PP 2; 0 fledged
LT 2; 4 fledged
ADULT CENSUS: PP 5, LT 6

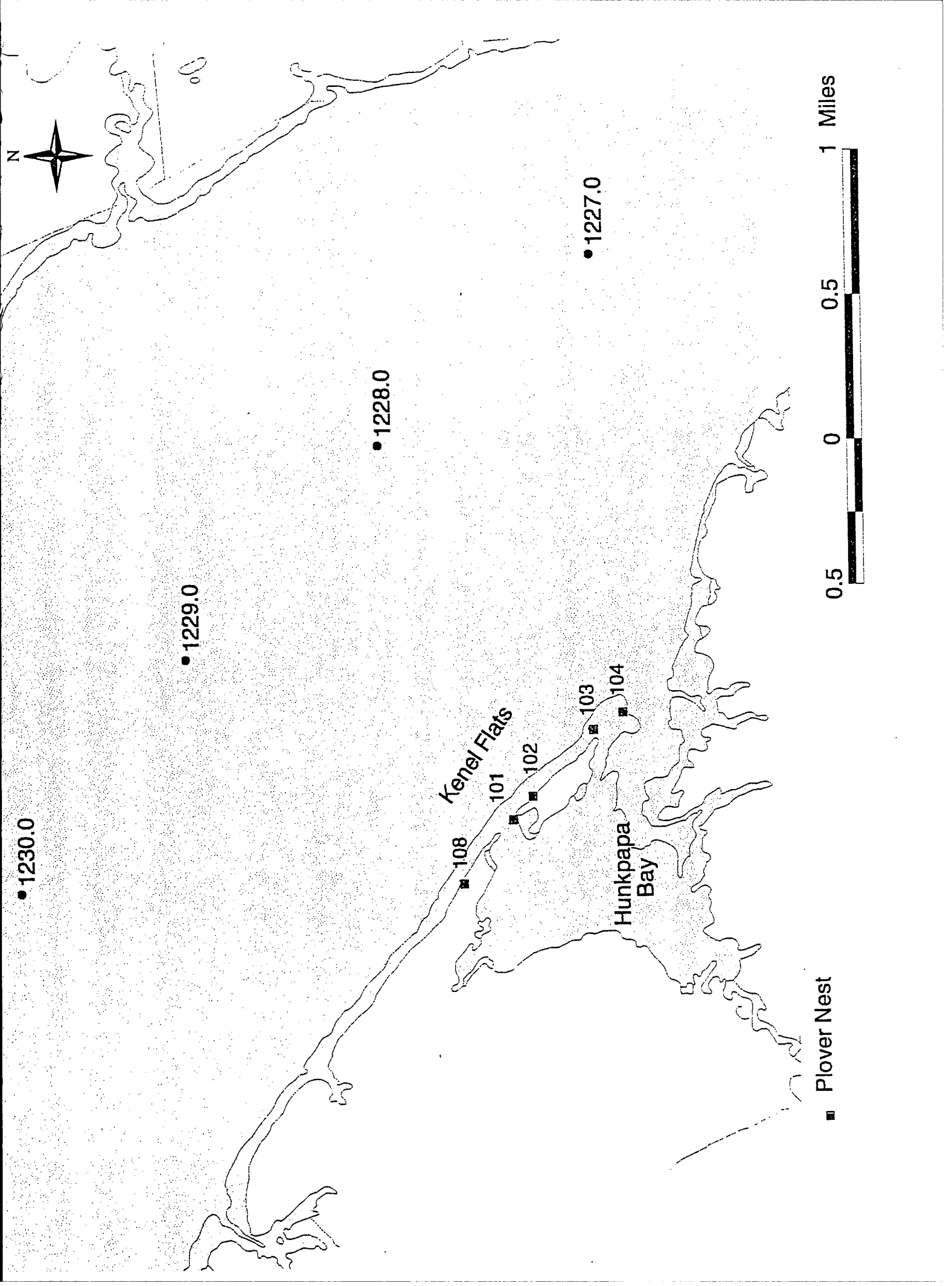


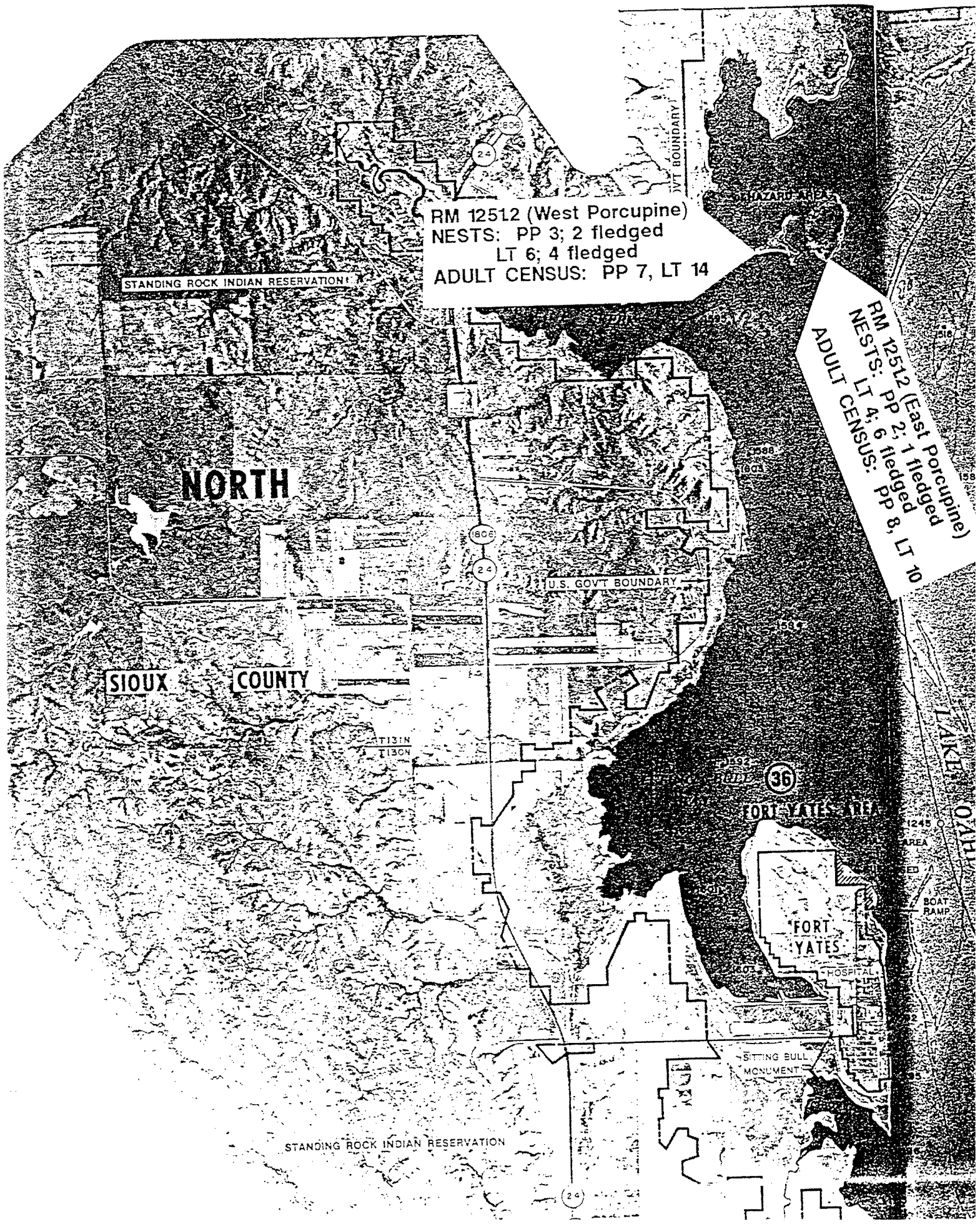
LEGEND:



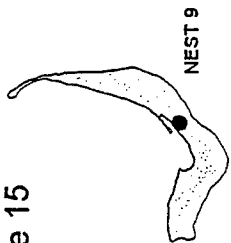
RM 1285.0 (South Huff)
 NESTS: PP 2; 2 fledged
 LT $\frac{1}{2}$ 0 fledged
 ADULT CENSUS: PP 2, LT 2





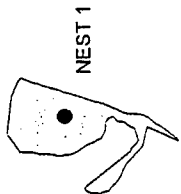


Site Location Map
Site 15



Swift
Bird

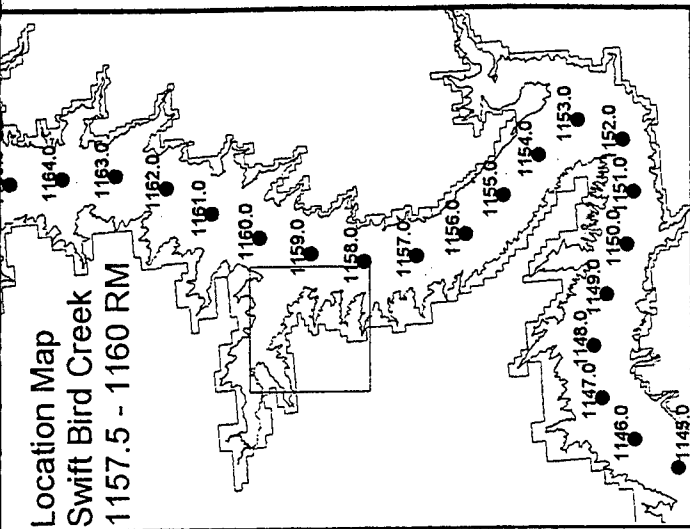
Site Location Map
Site 14



Location Map

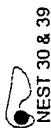
Swift Bird Creek

1157.5 - 1160 RM



Site Location Map
Sites 18, 3, & 2

Site Num 18



Site Num 3



Site Num 2

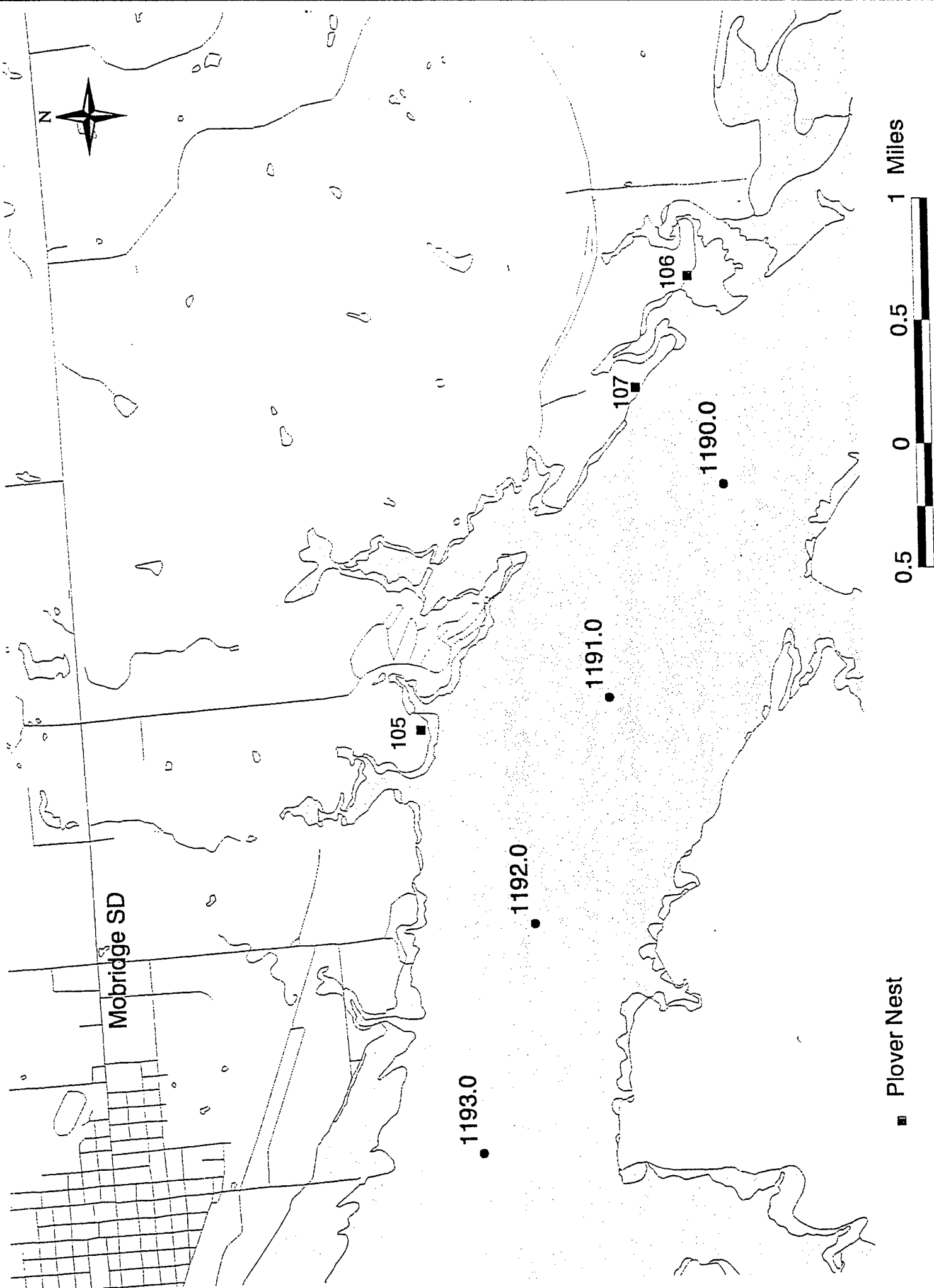


DEWEY CO
POTTER CO

Site Location Map
Site 1

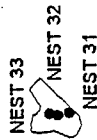


NEST 19

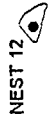


Site Location Map
Sites 19 & 12

Site Num 19



Site Num 12

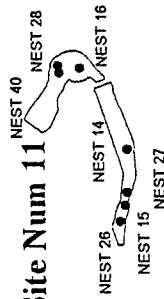


Site Location Map
Sites 10 & 11

Site Num 10



Site Num 11



Banded Plover
Site Location Map
Site 20

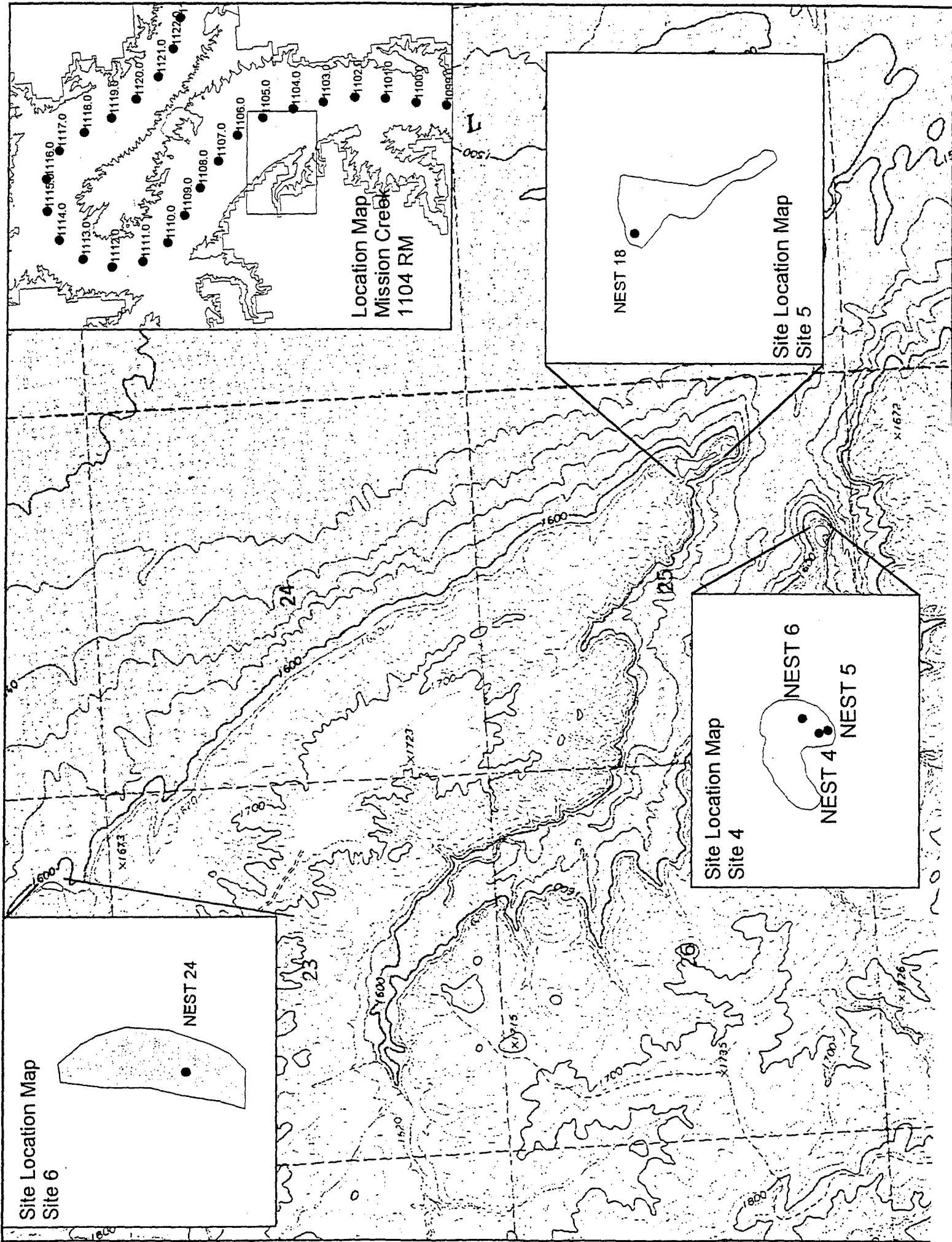


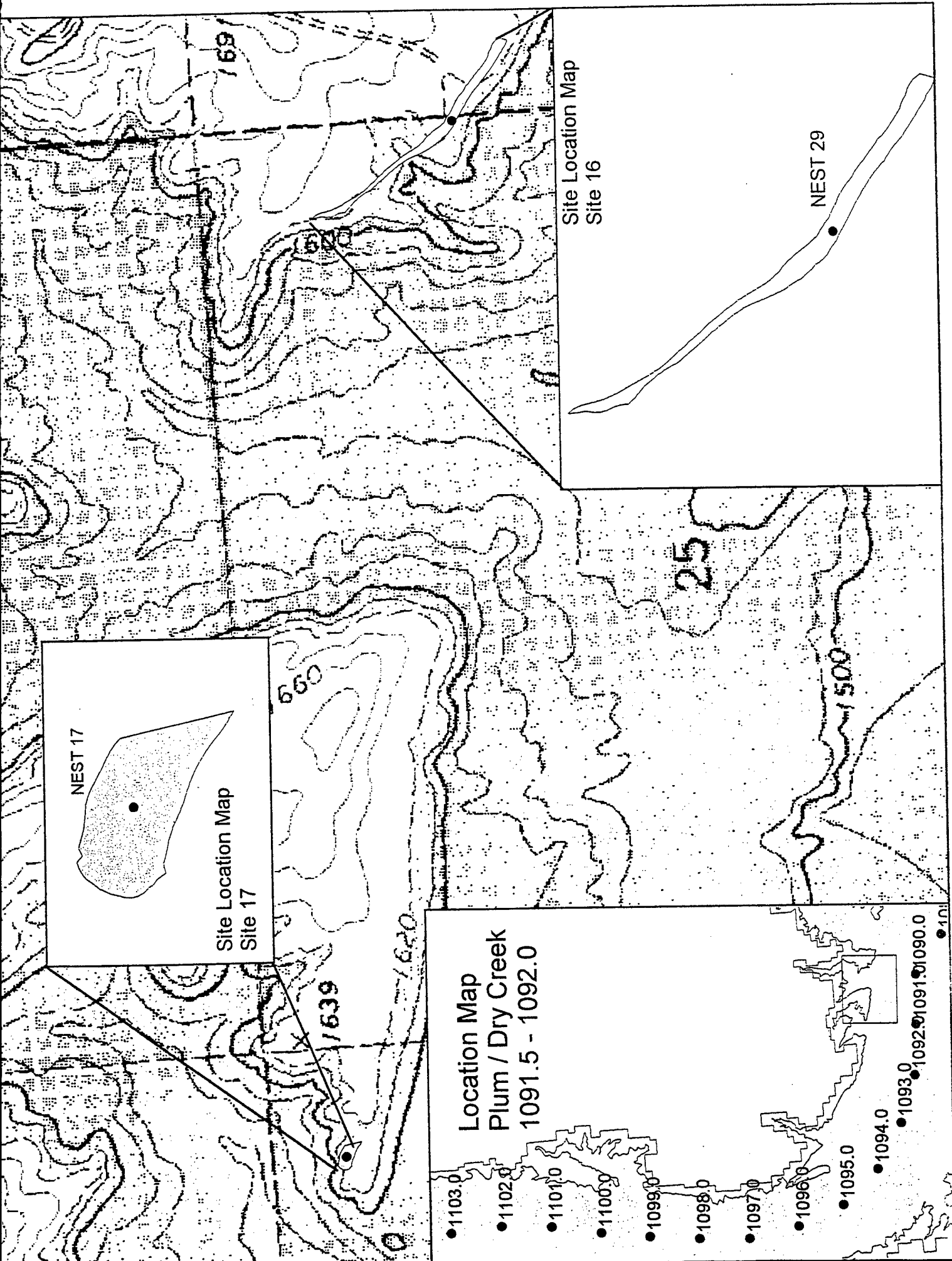
Site Location Map
Site 9

NEST 25

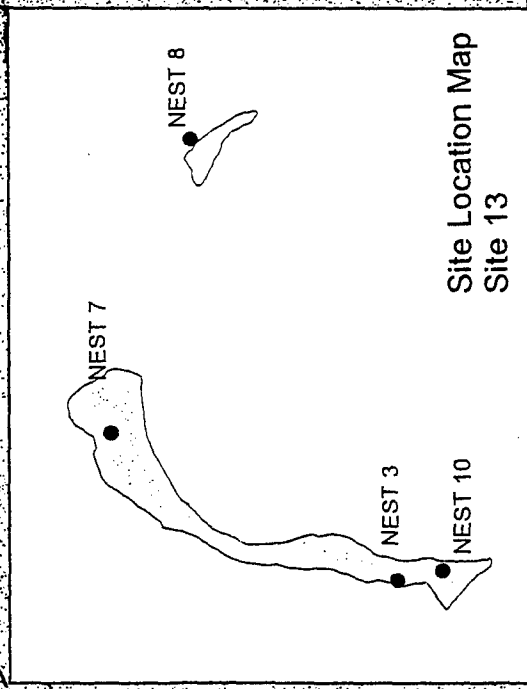
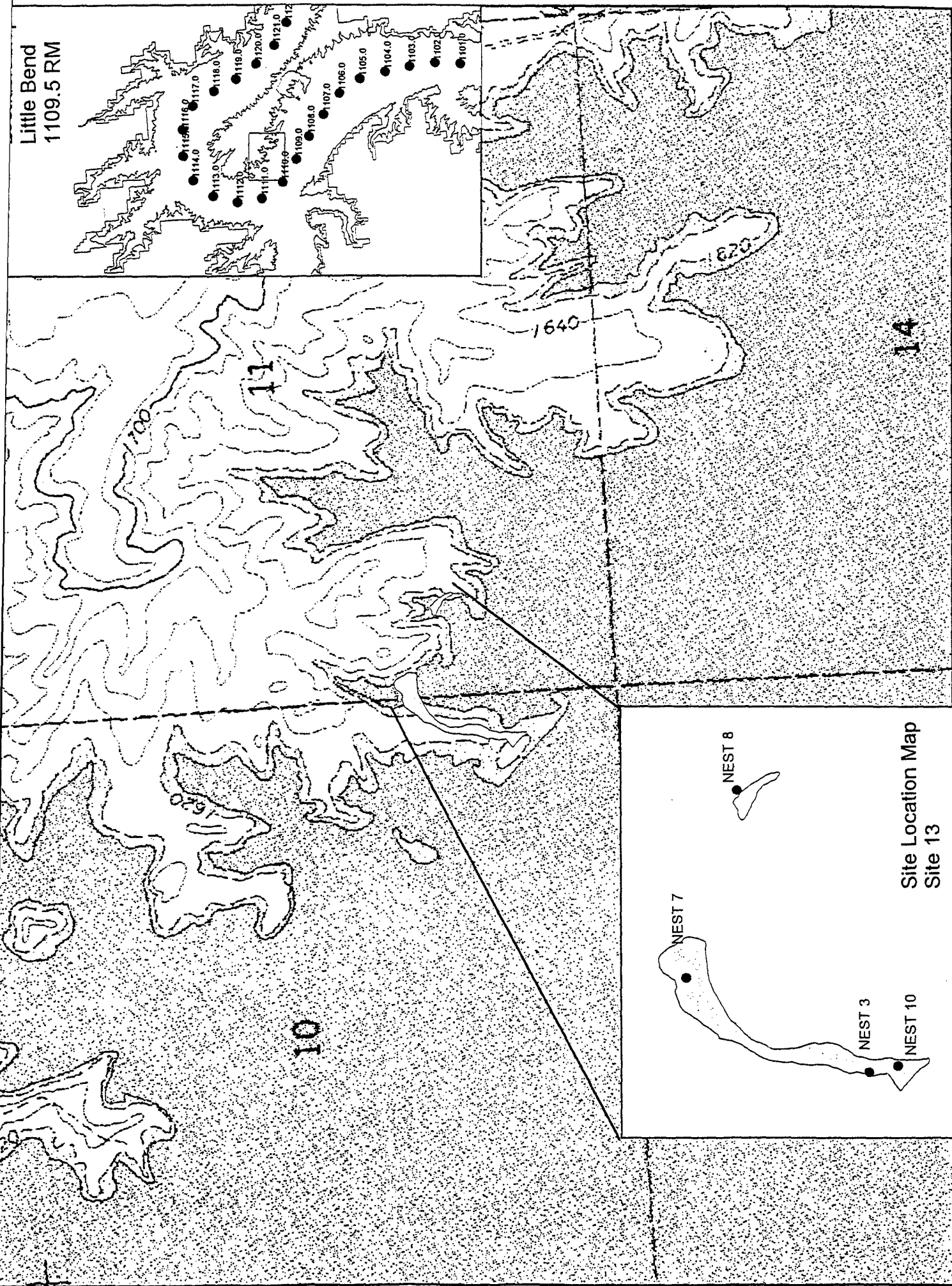
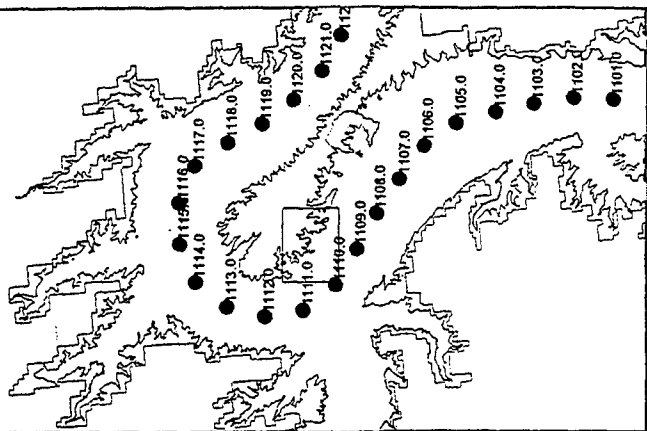
Site Location Map
Site 7



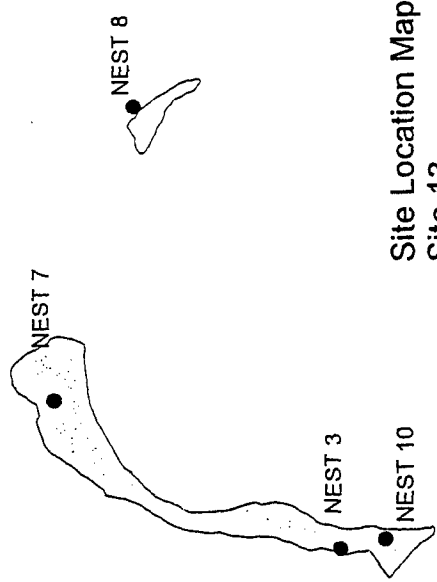




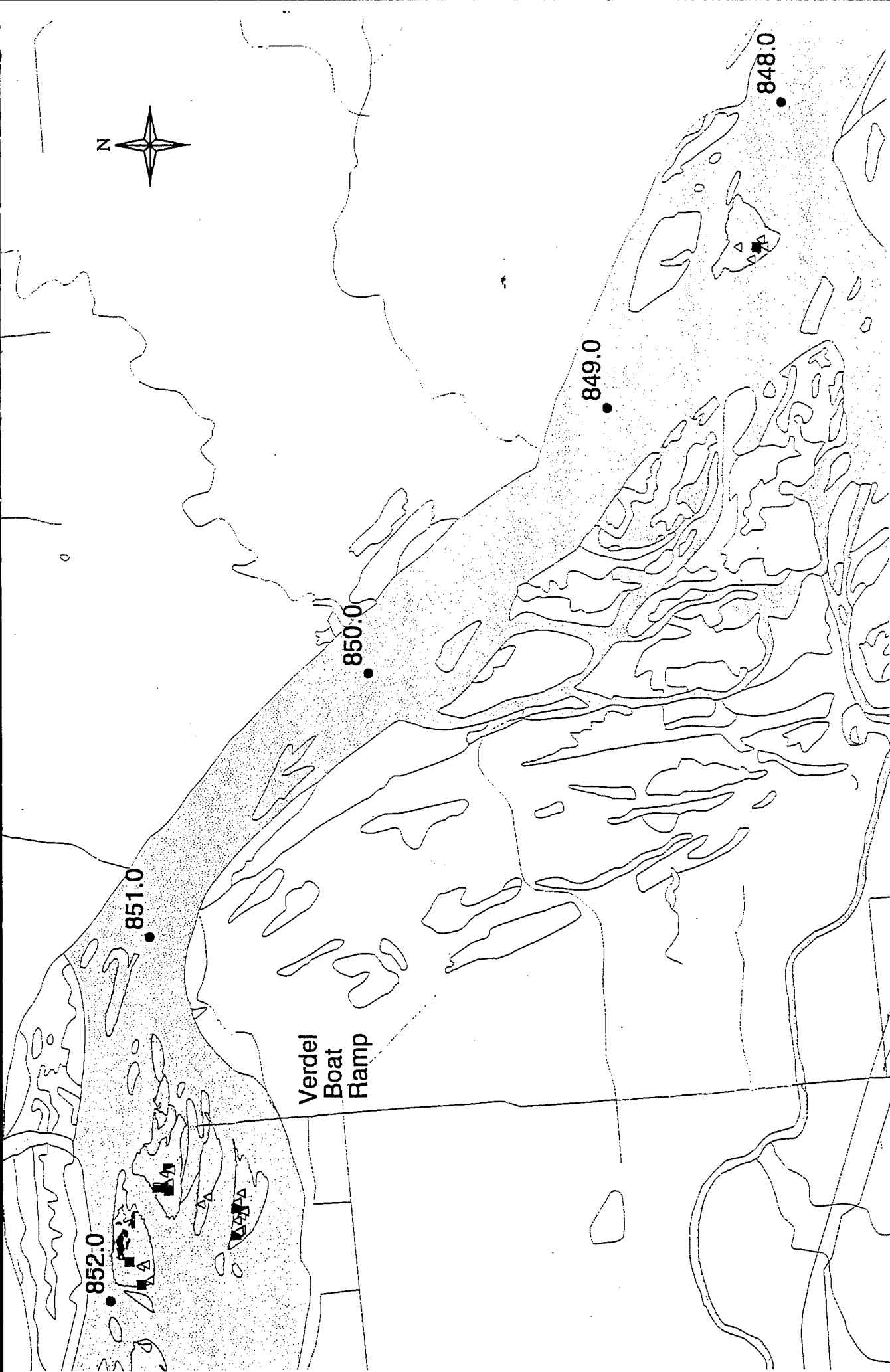
Little Bend
1109.5 RM



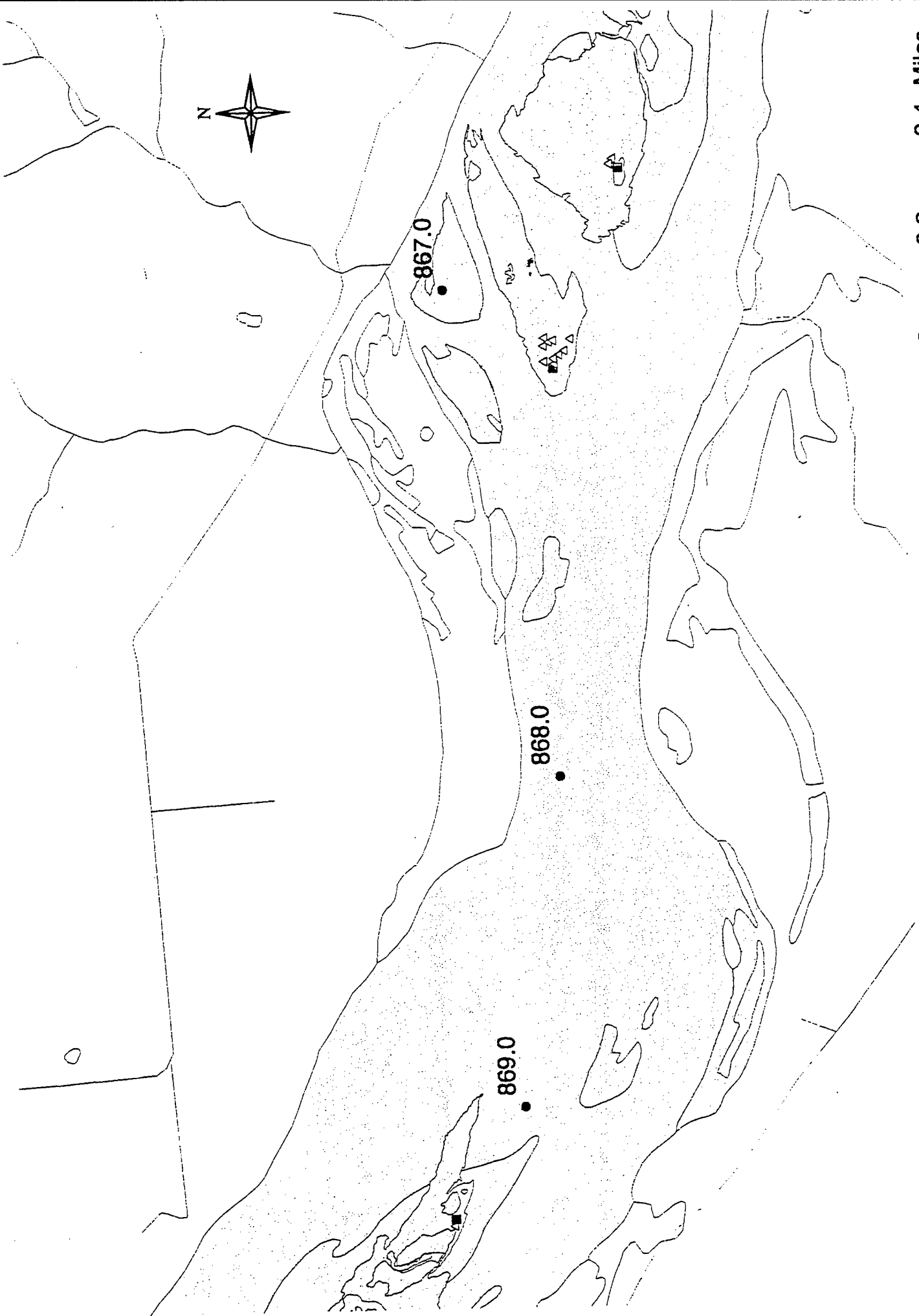
Site Location Map
Site 13



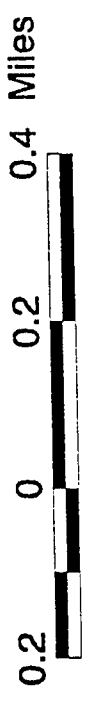
FORT RANDALL RIVER



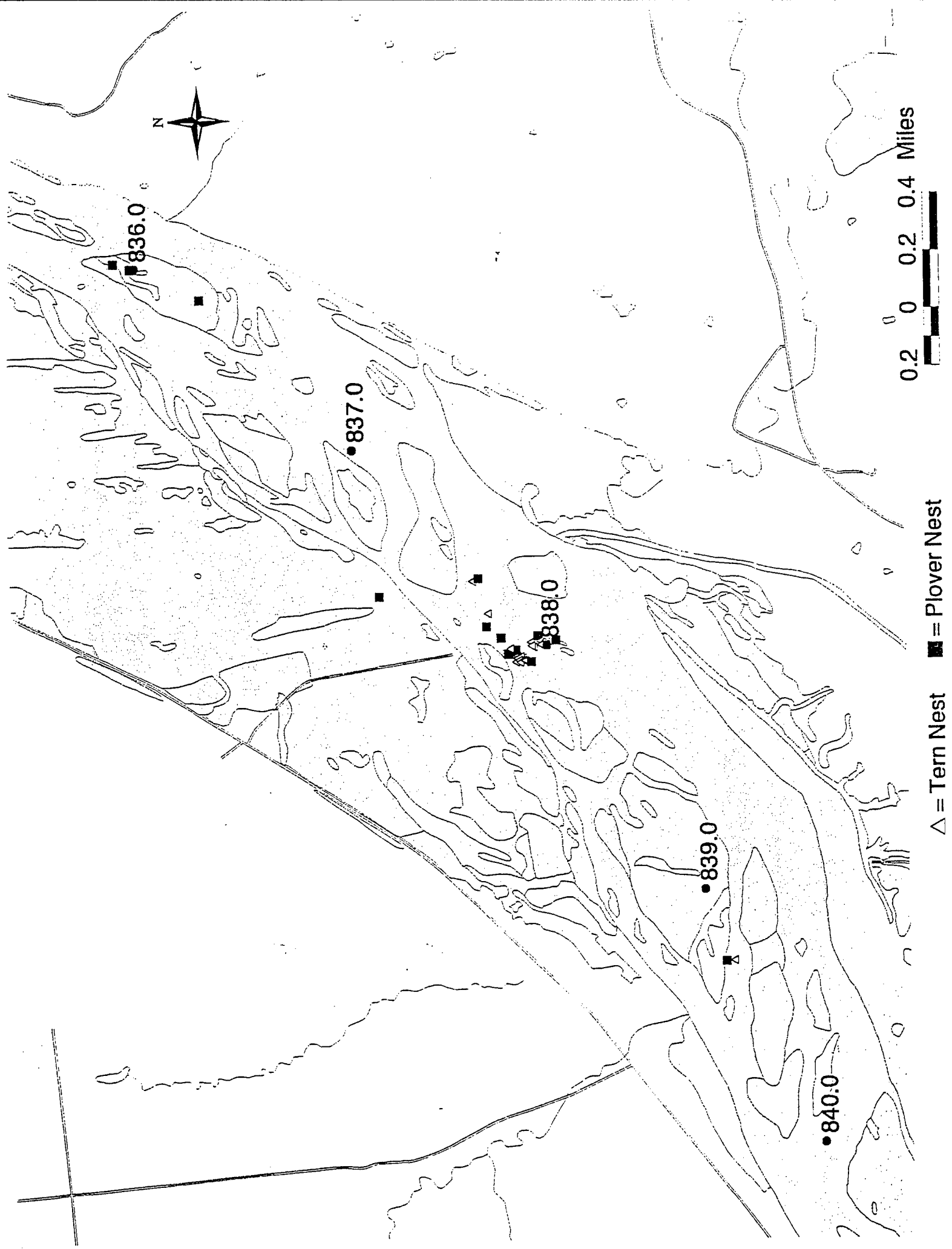
△ Tern Nest
■ Plover Nest

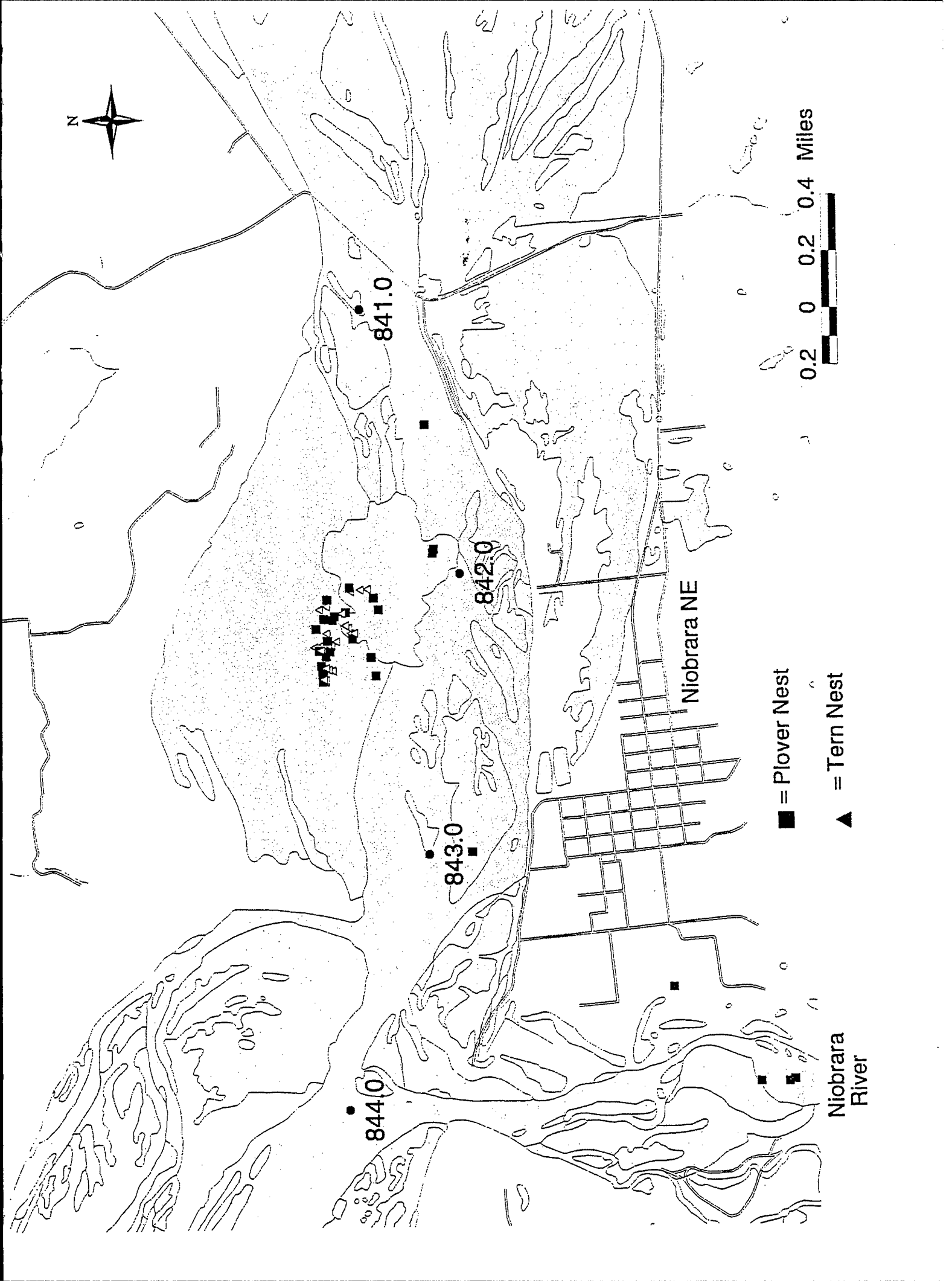


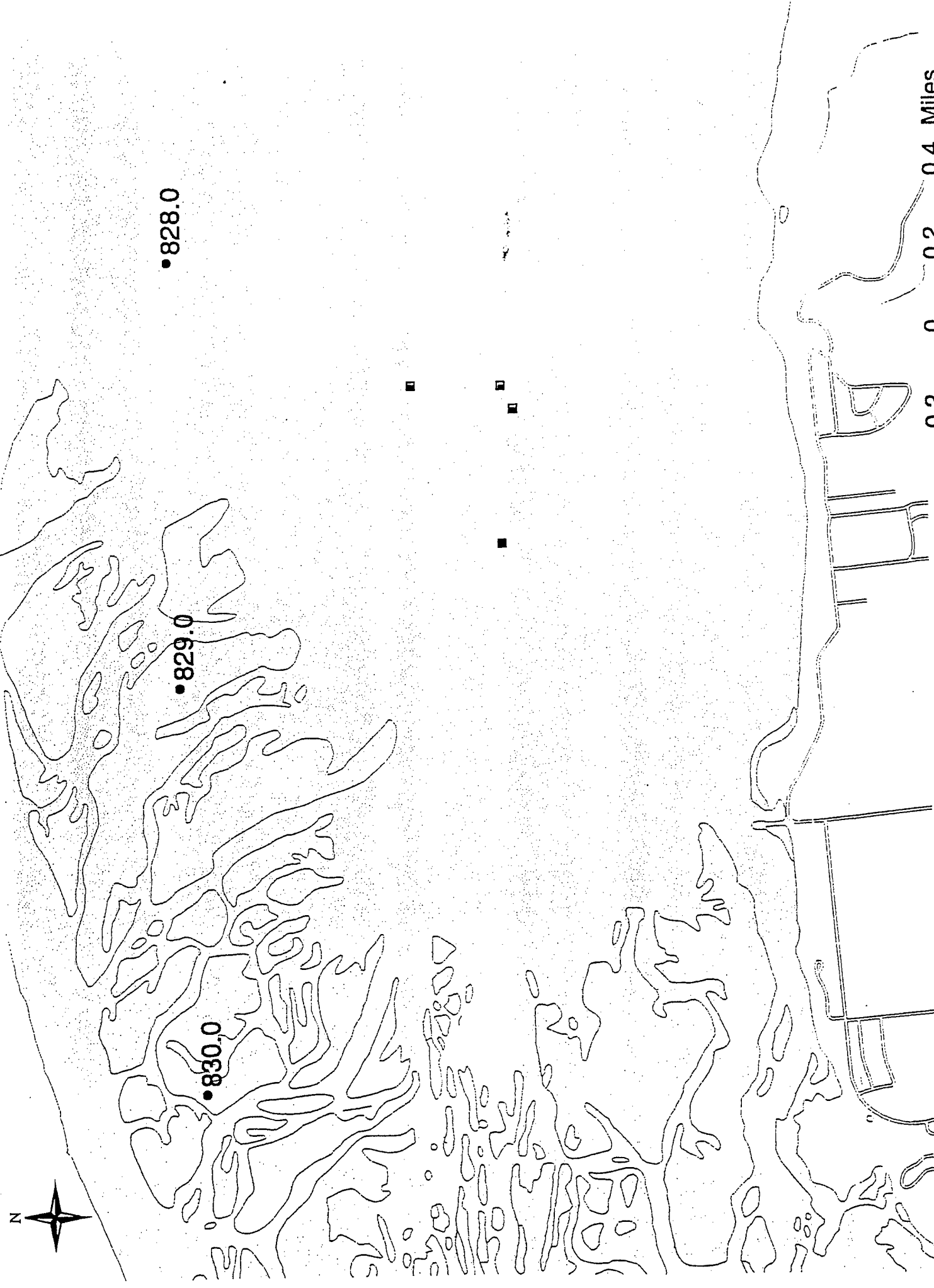
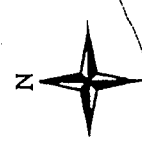
△ Tern Nest ■ Plover Nest



LEWIS & CLARK LAKE







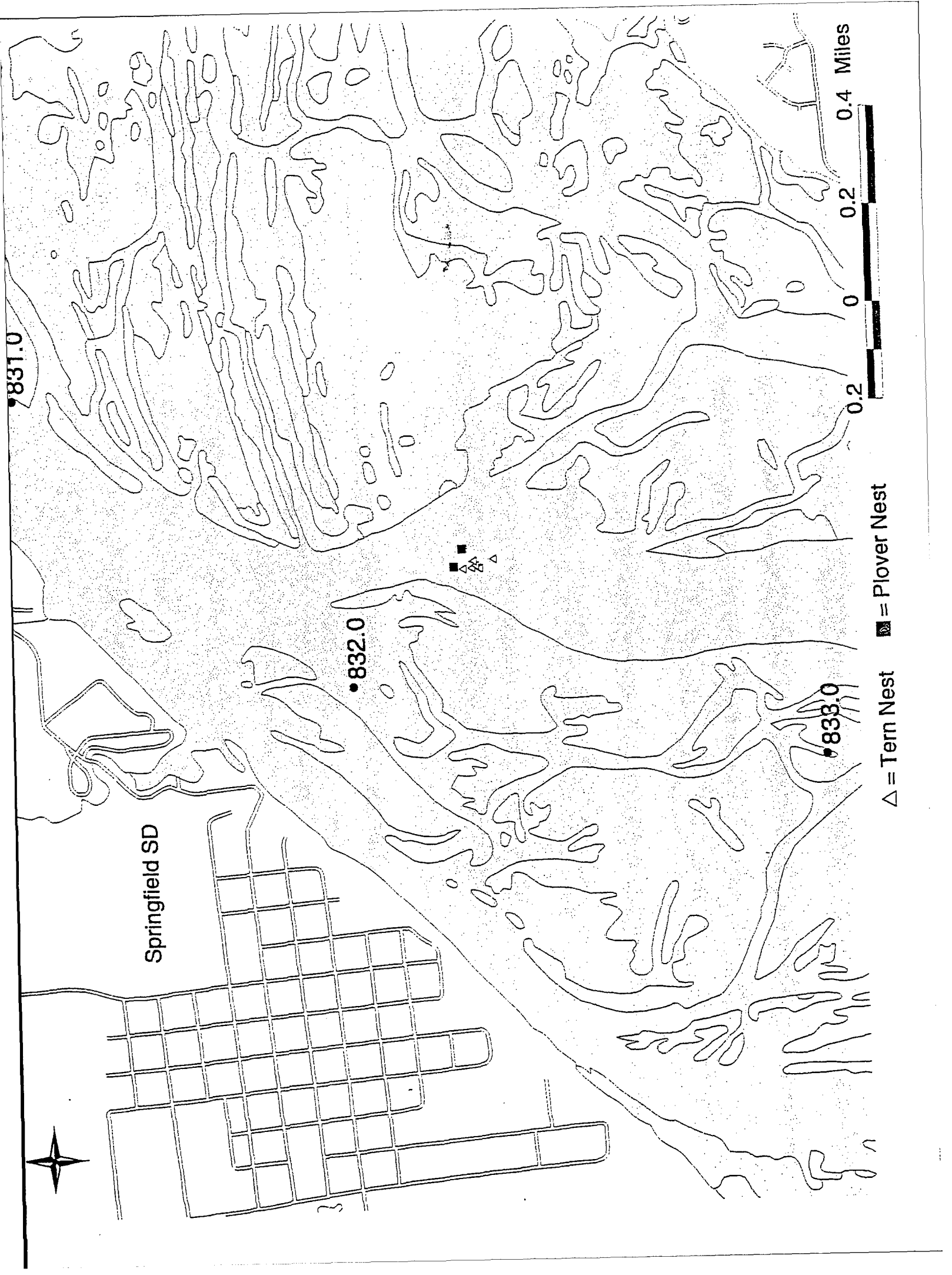
•828.0

•829.0

•830.0

△ = Tern Nest ■ = Plover Nest

0.2 0 0.2 0.4 Miles



831.0

Springfield SD

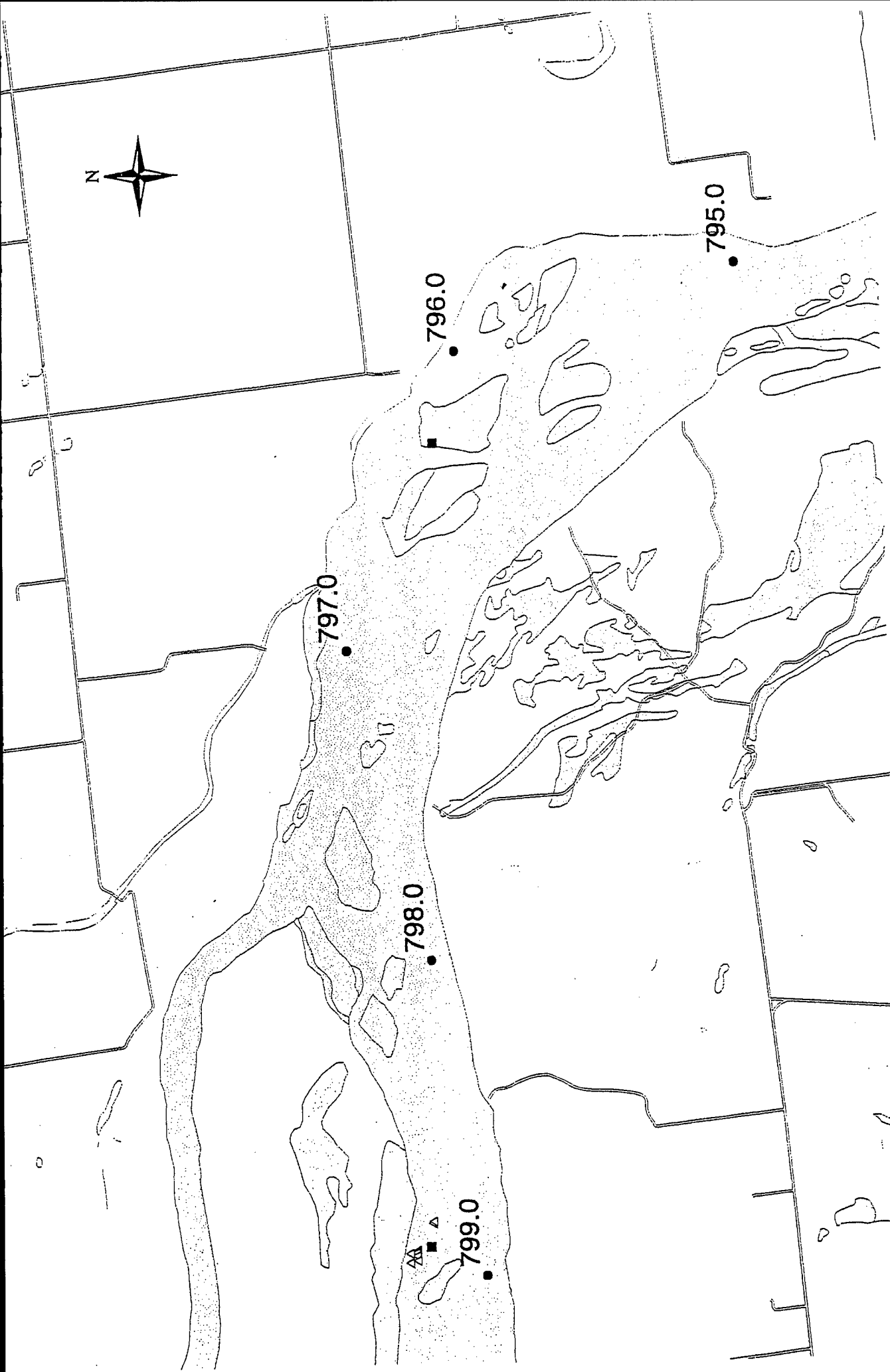
832.0

833.0

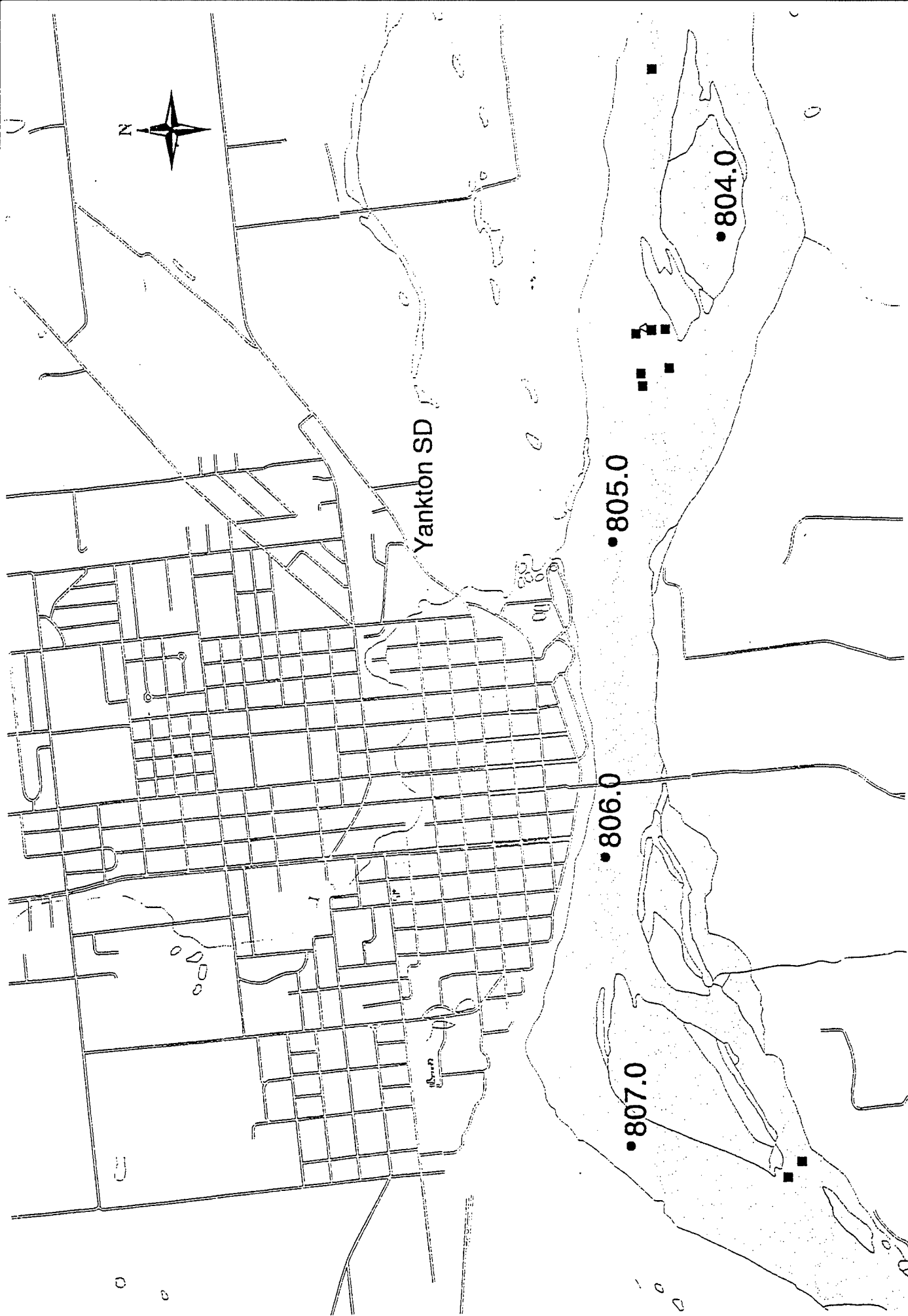
0.2 0 0.2 0.4 Miles

△ = Tern Nest
■ = Plover Nest

GAVINS POINT RIVER

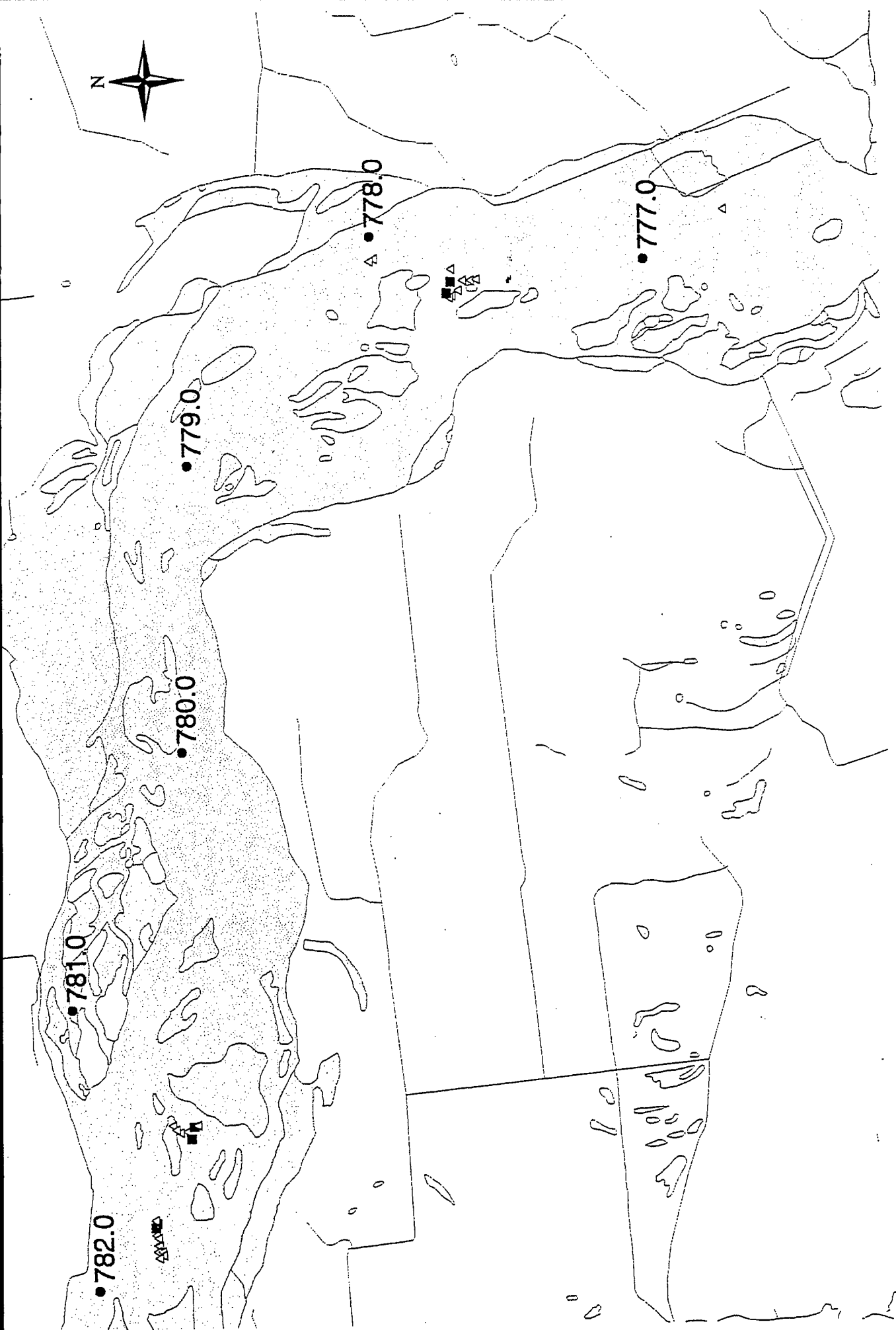


△ Tern Nest ■ Plover Nest

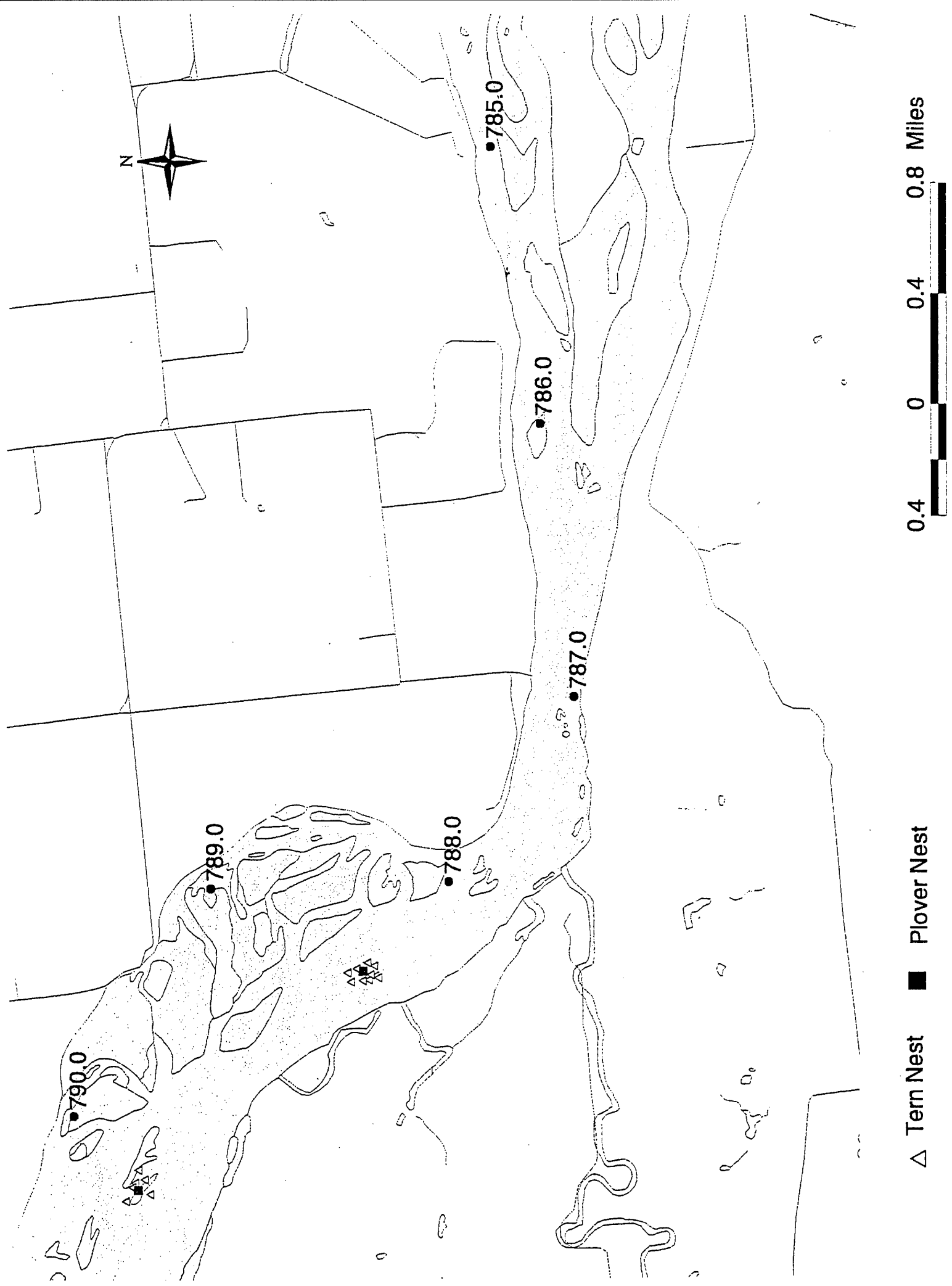


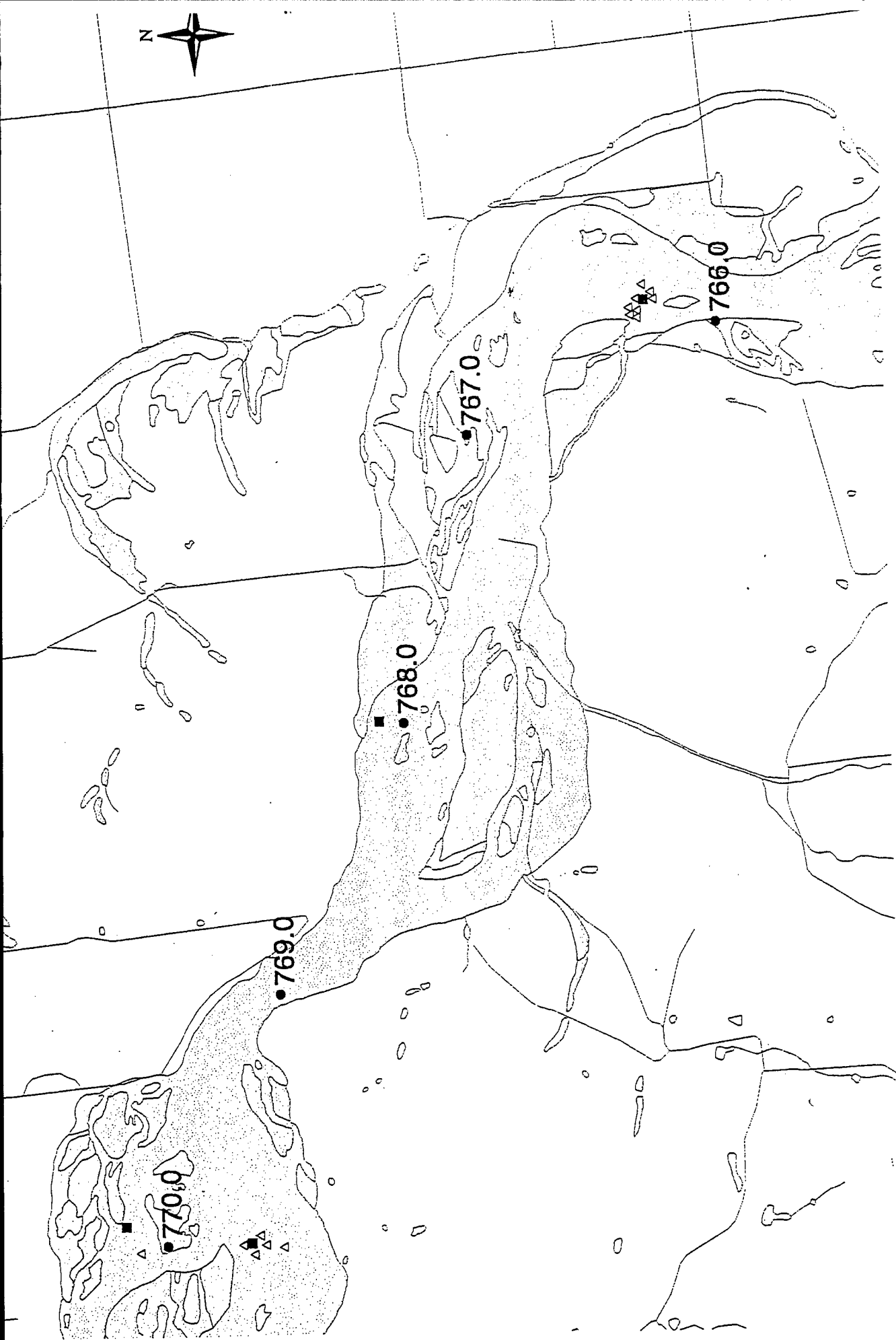
△ Tern Nest ■ Plover Nest

0.4 0 0.4 0.8 Miles



△ Tern Nest ■ Plover Nest





0.8 Miles

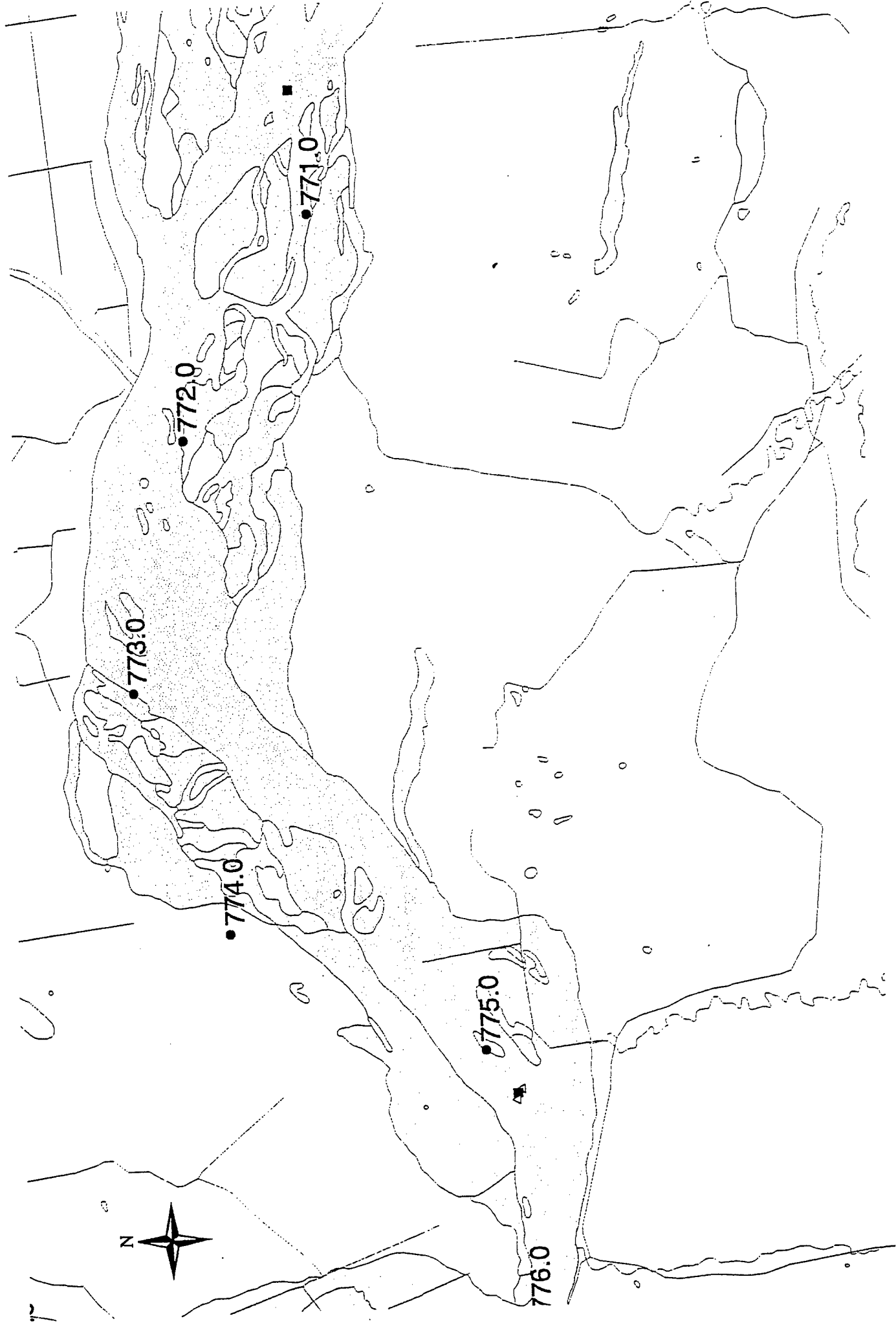
0.4

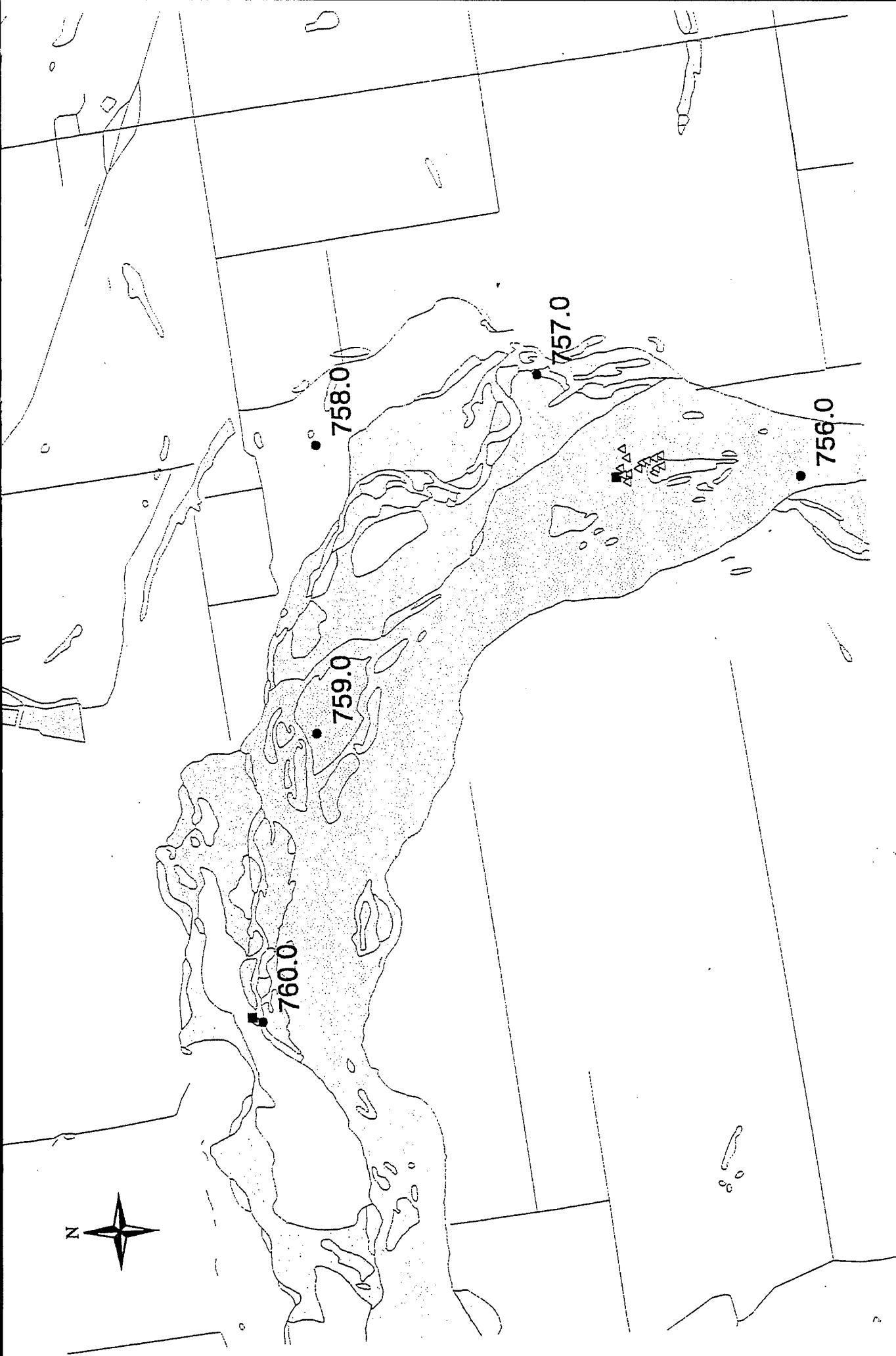
0

0.4

■ Plover Nest

△ Tern Nest





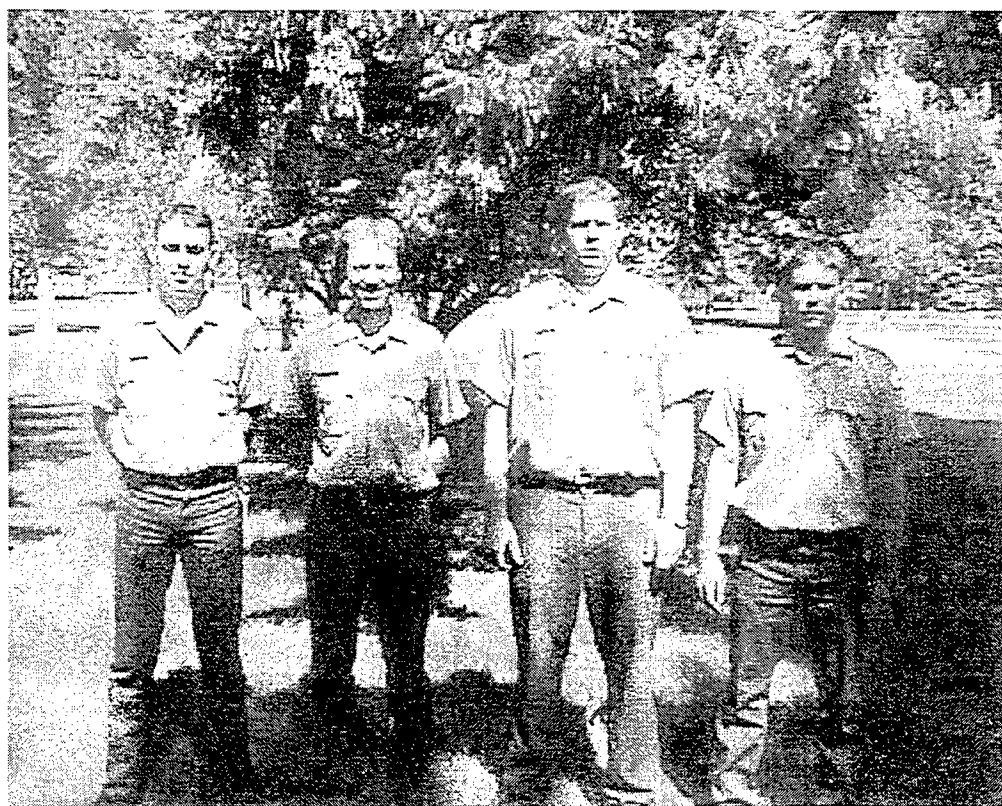
APPENDIX E

T&E Personnel Pictures

William Komar – Fort Peck Project

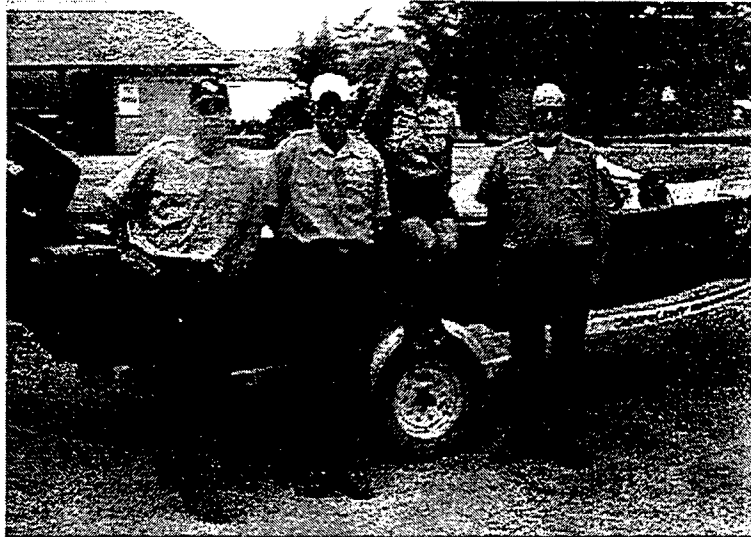


Benny Thatcher – Fort Peck Project



Riverdale Resource Office 1998 - Kelly Arndt, Barry Ploium, Jay Hettinger, Matt Nerby

Gavins Point Project – Joe Sees, Cory Loecker,
Stacy Adolf & Gene Bormann



University of Wisconsin
Jim Geise & Robyn Niver

APPENDIX D

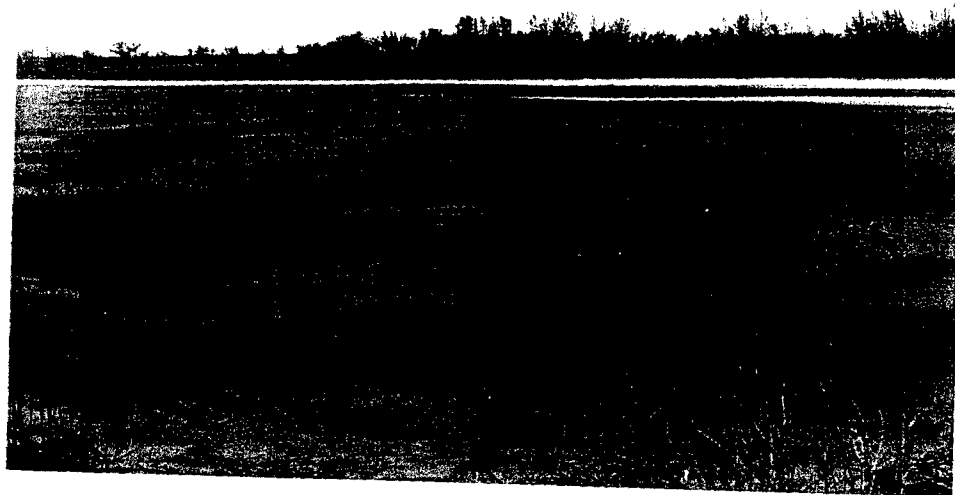
HABITAT WORK



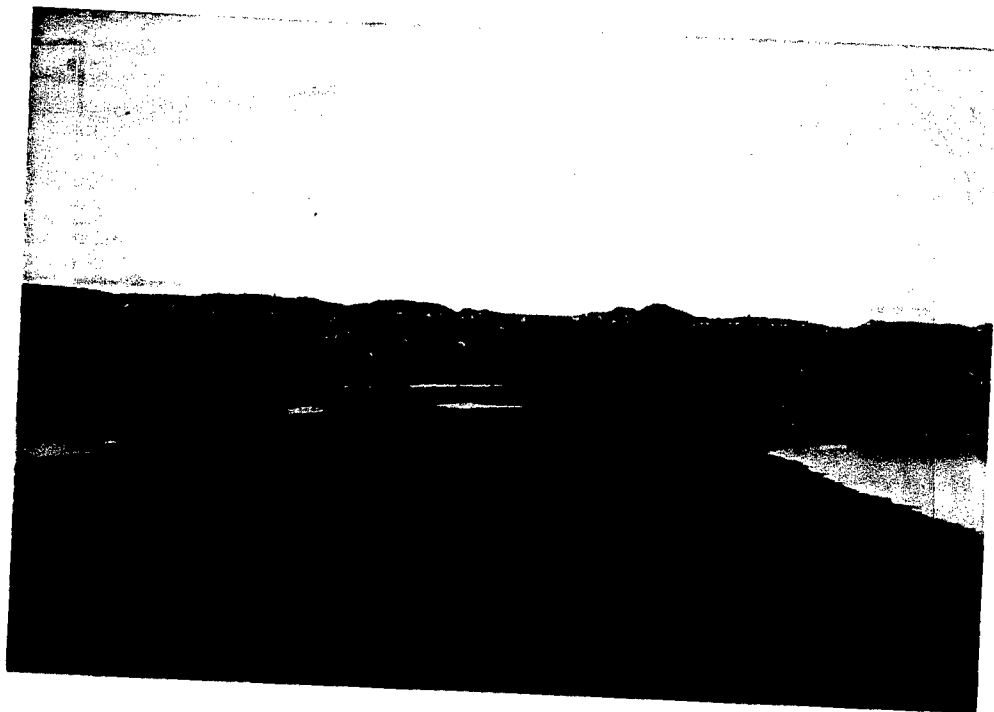
Habitat created by 1996-1997 high flows, and naturally maintained, looking east. This area is located in the Garrison River reach.



West end of same area. Note elevation of habitat.



Low-lying but naturally maintained habitat. RM 1580.5, approximately one mile south of the Yellowstone confluence.



Flow re-generated habitat at RM 1599.5.



Sprayed and mowed haabitat (with vegetative debris left from mower). Debris is buried by wind and depositing sand.

**PLOVER ISLAND CONTRUCTION
U.S. ARMY CORPS OF ENGINEERS
GARRISON PROJECT**

1. SCOPE OF WORK. The Contractor shall provide all labor, materials and equipment, and needed supervision necessary to construct Piping Plover habitat as indicated on the attached map according to specifications within this contract at Lake Audubon, Coleharbor, North Dakota.

2. MEETING WITH THE CONTRACTING OFFICER'S REPRESENTATIVE.

2.1 The Contractor shall be required to meet with the COR prior to commencement of the work to discuss and mutually agree on the performance, requirements, and administration of the contract. The Contractor at this prework meeting shall submit certificates and any copy of permits required within this contract and a work plan to include equipment and personnel requirements. The plan may be revised as needed to produce mutually acceptable plan for performance of the work required. Once approved, the work plan shall not be changed without approval of the COR. The meeting location will be at a place and time designated by the Contracting Officer's Representative.

2.2 A designated Contractor's Representative shall notify the COR (between 24 and 72 hours) prior to the beginning any work to review the planned work. Failure of the Contractor or his representative to meet this requirement without the approval of the COR may constitute grounds for termination of this contract.

2.3 The Contractor shall at the end of the project prior to submission of an invoice, contact the COR to agree on items to be included in that month's invoice.

3. DESCRIPTION OF WORK

3.1.1 **Work Location.** A general location map showing the project area within the scope of this contract is included. A design plan with specifications of the work site is also included in this contract.

3.1.2 Principal Component. Place approximately 5,433 cubic yards of material to build a one acre island at 1845' elevation above MSL with a slope to the water of 1 to 10 within the area known as Dike 1A on Lake Audubon. The material to be used for the construction of the island will be located at an onsite borrow site. Detailed plans will be included in the contract. When the grade is reached and the island is complete 360 cubic yards of sandy gravelly material will be place on the island. The grade of the material will Class 5 material.

3.1.3 Compaction. The contractor will need to ensure the island is compacted to prevent future erosion. The fill material shall be spread in horizontal layers not exceeding 8 inches in thickness(loos measurement) over the full width of the proposed island. No compaction other than that obtained by passage of the construction equipment over the work is required. The construction equipment shall be routed uniformly over the entire area of each layer.

3.1.4 Layout of Work. The government has established the primary control to be used for establishing lines and grades required for the work. The primary control consists of one permanent benchmark or temporary benchmark. Before beginning work, the contractor shall check and verify all control points established by the government and shall advise the government in writing that the points are acceptable or, if they are not acceptable, the reasons therefore.

The contractor will perform all necessary surveying in order to perform the work. All contractor survey work shall be under the direction of a surveyor or engineer who is qualified to supervise the work required by this paragraph. From the primary control points, the contractor shall lay out the work by establishing all lines and grades at the site necessary to control the work and shall be responsible for all measurements that may be required for the execution of the work, to the location and limit marks and tolerances prescribed in the specifications or on the drawings.

3.2 Road Maintenance and Restoration. The contractor will be responsible for all road maintenance and restoration of the roads due to damage caused by work associated with this project.

3.3 Environmental Protection

a. Scope. This paragraph prescribes actions required for the prevention of environmental pollution during and as a result of operations under this contract. For the purpose of this specification, environmental pollution is defined as the presence of chemical, physical, or biological elements or agents which adversely affect human health or welfare, unfavorably alter ecological balances of importance to human life, affect other species of importance to man, or degrade the utility of the environment for aesthetic and recreational purposes. The control of environmental pollution requires consideration of air, land, and water; and involves noise, solid waste management, management of radiant energy and radioactive materials, as well as other pollutants.

b. Protection of Land Resources. The work areas on which the work is to be performed under this contract and the land resources adjacent thereto should be preserved in their present condition.

c. Protection of Water Resources.

(1) Contamination of Water. Lakes, ditches, rivers, canals, waterways, or reservoirs shall not be polluted with fuels, oil, bitumens, calcium chloride, insecticides, herbicides, or other similar materials harmful to fish, shellfish, or wildlife; or materials which may be detrimental to outdoor recreation.

(2) Disposal of Materials. The methods and locations of the disposal of materials, wastes, effluent, trash, garbage, oil, grease, chemicals, etc., within the right-of-way limits shall be such that harmful debris will not enter lakes, ditches, rivers, canals, waterways, or reservoirs by erosion.

3.4 Equipment

3.4.1 The contractor shall furnish all equipment, labor supplies and materials and perform all work required for this contract.

3.4.2 The Contractor's equipment shall meet all federal, state, and local safety requirements.

3.4.3 The Contractor shall provide all personal safety equipment for workers. Workers shall wear protective equipment recommended by the manufacture while operating equipment.

4. PERMITS AND RESPONSIBILITIES. The Contractor shall, without additional expense to the Government, be responsible for obtaining all necessary licenses and permits and for complying with any applicable regulations federal, state, and local laws, codes, and regulations in connection with the prosecution of the work. The Contractor shall be similarly responsible for all damages to person or property, and Government property, that occur as a result of the Contractor fault or negligence.

5. SUB-CONTRACTING. No contract shall be made by the Contractor with any other party for furnishing any of the work or services herein contracted for without the approval of the Contracting Officer. This provision does not apply to contracts of employment between the Contractor and his personnel. Compliance with the provisions of this contract by sub-contractors shall be the responsibility of the Contractor.

6. INSPECTION OF WORK. The COR shall inspect the work as the contract progresses. All deficiencies noted shall be corrected. Additional work and cost required to correct deficiencies shall be the responsibility of the Contractor. The Contractor shall not be paid for any work performed that is not satisfactory to the COR or his/her representative.

7. NOTIFICATION OF DAMAGE OR VANDALISM. The Contractor shall notify the COR immediately of damage to Government or private property and injury to any person resulting from his/her operation. The Contractor shall advise the COR of damage to Government facilities due to vandalism or other causes on the day he/she notices such damage.

8. EMPLOYEE SAFETY LIABILITY. The Contractor shall be responsible for the safety of his/her employees and for any injury or damage done by them and shall protect the Government from any claims.

9. PERIOD OF CONTRACT. Any contract awarded as a result of this Request for Quotation shall become effective on September 1, 1998. When conditions warrant the contractor upon notification by the COR shall complete the work requirements within a period of 45 days. The time period may be modified by the COR due to unforeseen circumstances such as weather.

10. ACCEPTANCE OF WORK. Acceptance of work will be accomplished upon satisfactory performance of scheduled work and satisfactory correction on any and all deficiencies. Any deficiencies noted by the COR shall be corrected at no additional cost to the Government.

12. PAYMENT. Payment shall be made after completion of applications for services satisfactorily completed and accepted upon presentation to the Disbursing Officer of an invoice covering the services rendered. The unit prices bid shall be used in determining the amount to be paid for the work performed and accepted.

Bid Offering For Plover Island Construction Garrison Project

<u>ITEM</u>	<u>WORK</u>	<u>UNIT</u>	<u>UNIT PRICE</u>	<u>AMOUNT</u>
1.	Mobilization and preparatory work	For the lump sum of		\$_____
2.	Site cleanup and restoration	For the lump sum of		\$_____
3.	Road maintenance and restoration	For the lump sum of		\$_____
4.	Place and compact material for island	5,433 yd3	\$_____	\$_____
5.	Place and compact gravel layer	360 yd3	\$_____	\$_____
GRAND TOTAL				\$_____

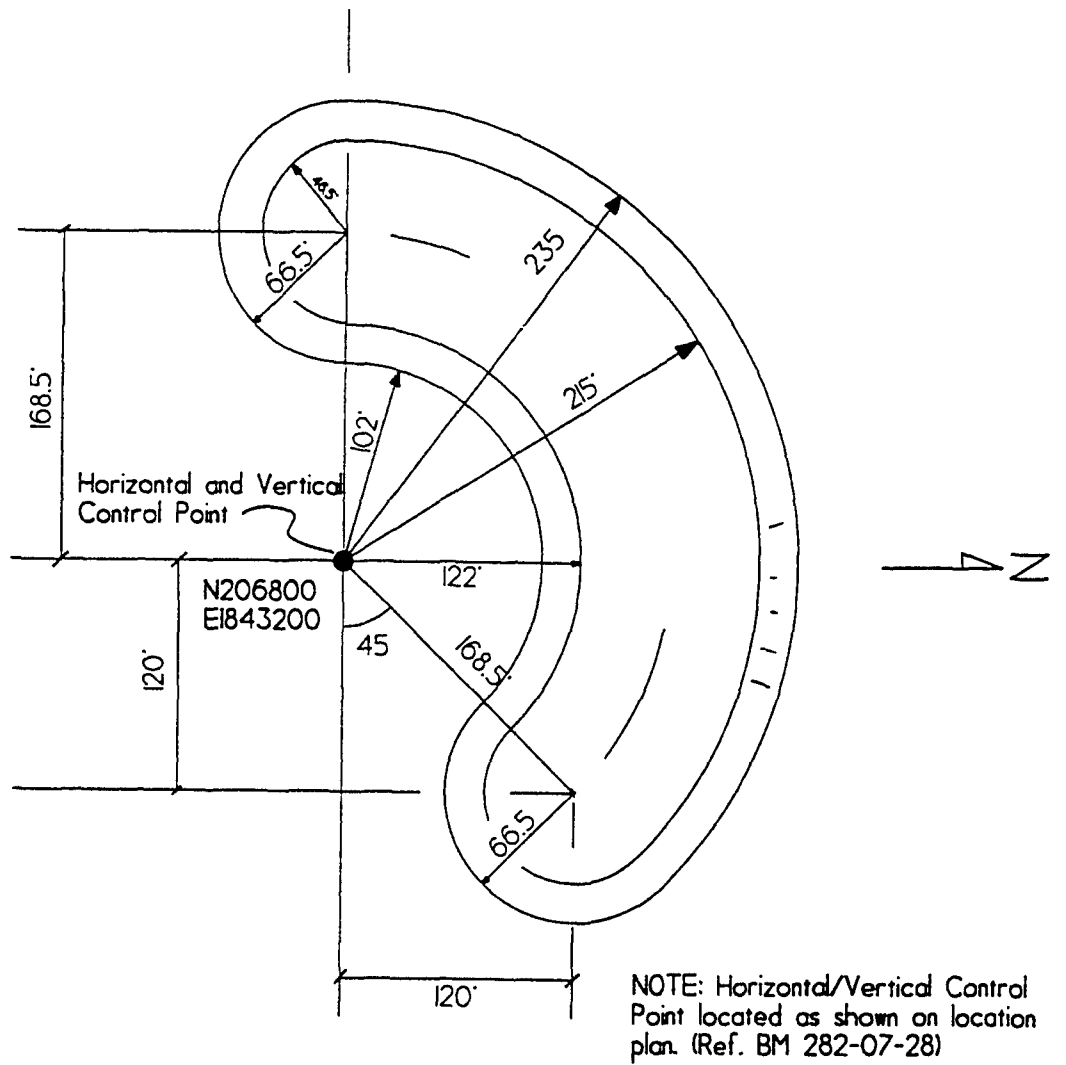
BIDDERS LIST

Holen Construction Company
380 Hwy 200 NE
McClusky, ND 58463

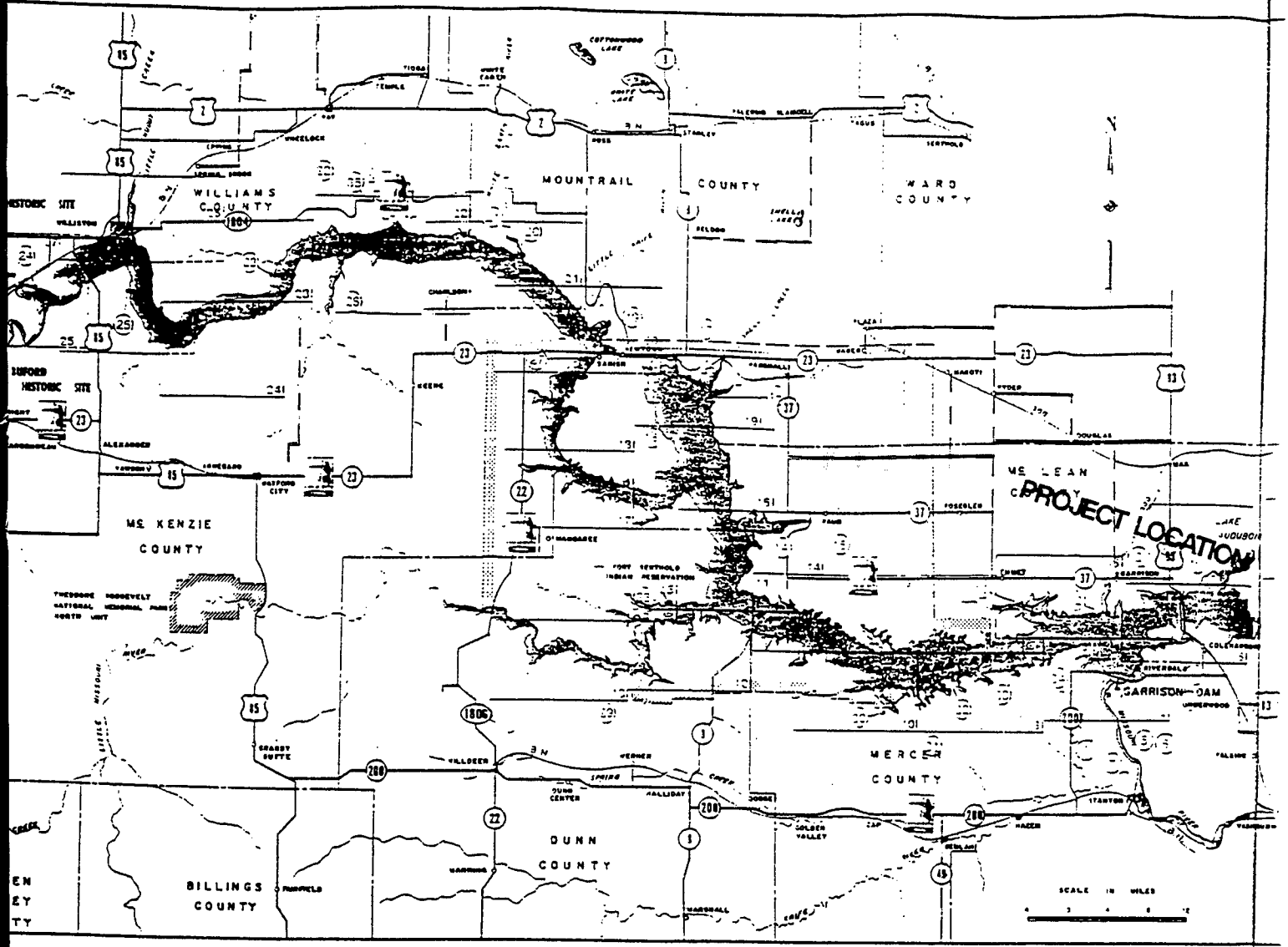
Harvey Sand and Gravel
P.O. Box 213
Harvey, ND 58341

Northern Improvement Company
P. O. Box 1254
Bismarck, ND 58502

Lindteigen Contruction
Box 459
Turtle Lake, ND 58575



PLAN



PLOVER ISLAND CONSTRUCTION GARRISON PROJECT

AUDUBON STATE GAME MANAGEMENT AREA

U.S. GOV'T BOUNDARY

AUDUBON NATIONAL WILDLIFE REFUGE

LAKE

AUDUBON

WORK SITE

BOUNDARY

FLOWER ISLAND CONSTRUCTION

GARRISON PROJECT

APPENDIX E

SURVEYS AND MONITORING

GOVERNMENT ORDER NO. W59XQG80751102
BETWEEN THE U.S. FISH AND WILDLIFE SERVICE AND THE OMAHA
DISTRICT U.S. ARMY CORPS OF ENGINEERS

SCOPE OF WORK AND TASK ASSIGNMENTS
Piping Plover and Least Tern Surveys and Productivity Monitoring
Fiscal Year 1998

PURPOSE AND AUTHORITY

This is a memorandum of understanding (MOU) entered into by and between the U.S. Fish and Wildlife Service (USFWS) and the Omaha District of the U.S. Army Corps of Engineers (Corps). The purpose of this MOU is to establish a scope of work, cost estimate, and responsibilities for the delivery of services to be performed as part of the Corps' responsibilities under the Endangered Species Act of 1973 (ESA), as amended. The accompanying government order purchase request (GO) is to obligate FY 98 funds to finance the continuation of services provided by the USFWS. The GO constitutes an order by the Corps, acting by and through the Contracting Officer, pursuant to the Economy Act, U.S.C. Section 1535, as implemented by the Federal Acquisition Regulation Supplement Subpart 217.5. Each of the parties hereto has the authority and is willing to enter into this MOU and to abide by its terms and conditions.

The Corps received a Biological Opinion (Opinion), concerning the operations of the Missouri River Main Stem System, from the US Fish and Wildlife Service in November 1990. This Opinion concluded that the current operations of the Missouri River would likely jeopardize the continued existence of the interior population of the least tern (*Sterna antillarum*) and the Great Plains population of the piping plover (*Charadrius melodus*). The Opinion provided reasonable and prudent alternatives that, if implemented, would preclude jeopardy to these species. Success of implementing the alternatives and subsequent preclusion of jeopardy, will be based on production, to be measured annually by fledge ratios of both the least terns and piping plovers nesting on the Missouri River. This scope of work for fiscal year 1998 outlines the mission that will be undertaken, not only by the parties entered into the forementioned MOU, but by all participating agencies who will survey populations and enhance and monitor production of both piping plovers and least terns within this region.

SCOPE OF WORK

I. Objectives

- A. Conduct annual census to estimate number of breeding pairs of least terns and piping plovers within the Fort Peck Reservoir.
- B. Monitor production of least terns and piping plovers nesting on Fort Peck Reservoir and document data using standardized methods, to allow for comparison of current years data with data previously collected within the system.
- C. Implement alternatives which are fiscally and logistically possible for the enhancement of least tern and piping plover productivity and the survival of young-of-the-year juveniles to flight stage.

II. Participating Agencies or Offices

USFWS, Ecological Services Sub-Office, Billings, MT

III. Geo-region Study Area

Fort Peck Reservoir, River Miles 1785.0-1771.0, Reach 1

IV. Breeding Adult Population Census

- A. Survey total numbers of adult least terns and piping plovers during the last week of June through the first week of July, 1998.
- B. Record all counts on standardized census record.

V. Productivity Monitoring

- A. Determine distribution of nesting least terns and piping plovers within the reach and record nest or nesting colony locations on US Army Corps of Engineers aerial mosaics or similar imagery.
- B. Determine earliest arrival dates and date of initial nesting or breeding activity within the reach. Determine latest nesting activity and date of last observation of both piping plovers and least terns using the habitat within the reach.

C. Conduct productivity monitoring activities on a 7 to 10 day cycle per site, as per permit conditions, and record all nest site and chick survival data in entirety on standardized data cards.

1. Collect nest data.

- a. Determine number of nests initiated, nest initiation dates, number of eggs laid, and number of eggs hatched.
- b. Determine principle causative factor or factors responsible for nest termination.

2. Collect chick survival data.

- a. Determine number of chicks fledged and estimate date of fledging.
- b. Determine principle causative factor responsible for chick mortality.

D. Collect all addled eggs and dead least tern and piping plover adults and chicks, and their parts for analysis by the USFWS, in accordance with procedures required by permit.

VI. Predator Deterrence

A. Implement predator exclosure cages on piping plover nests where predation is limiting or has historically limited nest success.

1. Exclosure cage design should be similar to those previously tested on nesting colonies within the Missouri River.
2. All cage designs, nest success, etc. should be discussed in the final report.

B. Test and implement other forms of predator deterrence or experimental removal (in coordination with USDA-Animal Damage Control office) in areas where predation appears to be limiting least tern and piping plover productivity.

VII. Other Activities

A. Assist in developing a database, using GIS and GPS equipment, of island geomorphological characters and their relationship to nesting site locations including, nest elevation, distance to nearest water, distance to vegetation, distance to shallow water feeding areas, distance to river bank, island topology, etc. Data collected will be used to generate weekly nest site location maps plotted on elevation data and also banked in an arc-info database for comparative analysis.

B. Conduct outreach activities to increase public awareness and knowledge about least terns and piping plovers and the role that they play within the Missouri River ecosystem. These activities should include, but not be limited to, press releases, public service announcements, interviews and/or tours with local media, participation in "awareness" days in the local areas, and daily

public relations. These activities should be undertaken in such a manner that all participating agencies and designated missions are spoken of and represented to the highest standard.

- C. Provide technical assistance to the Corps for development of better management alternatives and to aid in future planning and local recovery efforts of least terns and piping plovers on the Missouri River.

VIII. Reports

- A. Weekly status reports on least tern and piping plover surveying and monitoring results will be sent to Casey D. Kruse, Endangered Species Coordinator for the Operations Division, Omaha District on Friday of each week during the nesting season. These reports will include by site: number of active nests of each species, number of chicks present of each species, adult census (during weeks of the census), total number of fledged chicks of each species and any other pertinent information such as status of nests in relation to water elevation etc. Compiled reports will be forwarded on Monday morning of each week to respective state and federal offices. Reports will be discontinued when all activity is terminated in each respective reach.
- B. Final report will be due no later than October 15, 1998. Report will be sent to Casey D. Kruse, Endangered Species Coordinator for Operations Division, Omaha District. Guidelines for final report format will be forwarded.

IX. Agency Contacts

- A. US Army Corps of Engineers

Operations Division

FOR TECHNICAL ASSISTANCE
Casey D. Kruse
Endangered Species Coordinator
PO Box 710
Yankton, SD 57078
(402) 667-7873 ext. 3333

FOR CONTRACT ASSISTANCE
John Kirwan
CENWO-OD-TN
215 N 17th St.
Omaha, NE 68102-4978
(402) 221-4686

- B. U.S. Fish and Wildlife Service

Montana

Lou Hanebury (406) 247-7366
CMR National Wildlife Refuge (406) 526-3464

OBLIGATION/REIMBURSEMENT OF FUNDS

The following is a cost breakdown for USFWS participation in the scope of work in FY 98:

Personnel	
Wildlife Biologist	\$3,000
Technician	1,000
Vehicle/Boat	1,000
Equipment	500
Miscellaneous	<u>500</u>
Subtotal	\$6,000
 Overhead @ 17%	 <u>1,020</u>
 TOTAL	 \$7,020

It is anticipated that this work will be completed by the U.S. Fish and Wildlife Service-Ecological Services Sub-Office in Billings, MT. This amendment provides the USFWS with the authority to be reimbursed by the Corps for costs incurred for work completed in fiscal year 98. Funds not to exceed \$7,020, including 17 percent overhead, are available for work completed in fiscal year 98. The funding citation is 96X3123 OWI-001TN1, FWI-001TL8, GO PR&C# W59XQG80751102. The USFWS shall submit invoices (via standard form 1080, if desired) for the costs of performing the work described above, not more than once per quarter to:

U.S. Army Corps of Engineers, Omaha District
ATTN: CEMRO-OP-S (Marilyn Knapp)
215 North 17th Street
Omaha, NE 68102-4978

The invoices should reference the GO PR&C. The effective date of this amendment shall be the date of signature by the authorized representative of the USFWS (see signature block on MIPR).

MILITARY INTERDEPARTMENTAL PURCHASE REQUEST

PAGE 001

FSC	CONTROL SYMBOL NO.	DATE PREPARED	MIPR NUMBER	AMEND NO.
		16-MAR-1998	W59XQG80751102	000

TO: U.S. FISH & WILDLIFE SERVICE,

ROCKY MOUNTAIN REGIONAL OFFICE
P.O. BOX 25486
DENVER FEDERAL CENTER
DENVER ,CO 80225

FROM: TECH SPRT BR NTR RSC MGM
CENWO-OP-TN
215 N 17TH STREET
ZORINSKY BLDG

OMAHA NE 68102-4978

ITEMS __ ARE __ ARE NOT INCLUDED IN THE INTERSERVICE SUPPLY SUPPORT PROGRAM AND REQUIRED INTERSERVICE
SCREENING __ HAS __ HAS NOT BEEN ACCOMPLISHED.

ITEM NO.	DESCRIPTION (Federal stock number, nomenclature, specification and/or drawing No., etc.)	QTY	UNIT	ESTIMATED UNIT PRICE	ESTIMATED TOTAL PRICE
1	1998 TERN & PLOVER CENSUS/SURVEYS ON FORT PECK RESERVOIR	0	LS	.00	\$7,020.00
ACCOUNTING CLASSIFICATION 96 NA X 3123.0000 G6 1996 08 2417 006440 2500 001TL8 300 96252					
WORK CAT CODE: 60510 WORK CAT ELEM CODE: 99998					

Please have the accepting official sign below and return to the FINANCIAL POC address. EXPIRATION DATE 30-SEP-1998

TECHNICAL POC: CASEY D KRUSE

FINANCIAL POC: MARILYN M KNAPP

CENWO-OP-S

FINANCIAL POC ADDRESS: MANAGEMENT SUPPORT BRANCH

215 N 17TH STREET

ZORINSKY BLDG

OMAHA NE 68102-4978

ACCEPTED REIMBURSABLE ORDER _____ DATE _____ TITLE _____

SEE ATTACHED PAGES FOR DELIVERY SCHEDULES, PRESERVATION AND PACKAGING INSTRUCTIONS, SHIPPING
INSTRUCTIONS AND INSTRUCTIONS FOR DISTRIBUTION OF CONTRACTS AND RELATED DOCUMENTS. GRAND TOTAL \$7,020.00

TRANSPORTATION ALLOTMENT (Used if FOB Contractor's plant)

MAIL INVOICES TO (Payment will be made by
FINANCE AND ACCOUNTING BRANCH
USAED OMAHA DISTRICT
215TH NORTH 17TH STREET
FEDERAL ZORINSKY BLDG.
OMAHA NE 68102-4978

FUNDS FOR PROCUREMENT ARE PROPERLY CHARGEABLE TO THE ALLOTMENTS SET FORTH ABOVE, THE /S/ MICHAEL A CLARK
AVAILABLE BALANCES OF WHICH ARE SUFFICIENT TO COVER THE ESTIMATED TOTAL PRICE. STAFF ACCOUNTANT

16-MAR-199

AUTHORIZING OFFICER

SIGNATURE

DATE

MARILYN M KNAPP

/S/ MARILYN M KNAPP

16-MAR-199

PROGRAM ANALYST

Endangered Species Report

Missouri River Basin - System Summary - April 26 - May 1, 1998

Fort Randall Reach: The Missouri was surveyed to river mile 866. No birds of either species were seen.

Lewis & Clark Lake: The mouth of the Niobrara was surveyed on April 27. Sixteen piping plovers were observed. No nests were located but two nest scrapes were found.

Gavins Point Reach: A survey of a small portion of the river was conducted on April 28. Five piping plovers were observed at RM 804.5.

Special Notes:

1. Kyle Drake, graduate student Texas A&M Kingsville, reported on April 26 that the piping plovers he had been monitoring on the wintering grounds near Galveston Texas have all departed. He believes they are winging their way north to the nesting grounds.
2. Stacy Adolf, endangered species coop student, has accepted a position with the U.S. Fish & Wildlife Service at De Lacs National Wildlife Refuge in North Dakota.

Endangered Species Report

Missouri River Basin - System Summary - May 9 - May 16, 1998

Fort Peck Lake: The lake was surveyed on May 12 - 14. 27 beaches were checked. One piping plover was observed at Beach 5.

Fort Peck River Reach: The upper sample was not surveyed. No piping plovers were observed on the lower subsample, but 12 black bellied plovers were seen at RM 1586.5.

Lake Sakakawea Reach: No plovers were observed on the upper lake and seven plovers were observed around Steinke Bay on the lower lake.

Garrison Reach: The Missouri was surveyed from 1389 to 1300. No plovers or terns were observed on the river.

Lake Oahe Reach: Eleven plovers were observed at four locations in the Pierre section of the lake. No plovers were seen on the Mobridge and Bismarck portions of the lake. Habitat on the lake is reported as being extremely good.

Fort Randall Reach: The reach was surveyed on May 13. No birds of either species were observed.

Lewis & Clark Lake: The mouth of the Niobrara was surveyed on May 13. Five plovers were seen and though a nest scrape was observed, no nests were found.

Gavins Point Reach: The river was surveyed on May 14 - 15 from RM 807 to RM 801. Very few plovers were observed but a two egg plover nest was found on a sandbar at RM 804.5.

Statistics: 1 plover nest (1 new)

Special Notes:

1. Robyn Niver arrived at the Gavins Point Project on May 13 to begin her graduate work on piping plover chick survivability.

Endangered Species Report

Missouri River Basin - System Summary - May 17 - May 23, 1998

Fort Peck Lake: The lake was surveyed on May 12 - 14. 27 beaches were checked. One piping plover was observed at Beach 5.

Fort Peck River Reach: The upper subsample was surveyed on May 19 from RM 1714 to RM 1688. No birds of either species were observed. The lower subsample was surveyed during the week. No birds of either species were seen.

Lake Sakakawea Reach: Three plovers were observed on the upper lake but no nests were found. Two plover nests were found at Steinke Bay. Total - 2 plover nests (2 new)

Garrison Reach: The Missouri was surveyed from 1389 to 1355. Two plovers were found at RM 1380.

Lake Oahe Reach: No birds of either species were seen on the Bismarck section of the lake. On the Mobridge section four plover nests were found at the Kanel Flats area between RM 1228.4 and RM 1227.3. On the Pierre section one plover nest was found at Swiftbird and two plovers were seen at Little Bend. Total - 5 plover nests (5 new)

Fort Randall Reach: The reach was surveyed on May 18 - 20. Two terns were seen at RM 869. Sixteen plovers were seen at seven locations. Nest scrapes were found at three of these locations.

Lewis & Clark Lake: The mouth of the Niobrara was surveyed on May 20. Two terns and nine plovers were seen. One egg plover nest was found. Lewis & Clark Lake was surveyed on May 21. Three plovers were seen, but no nests were found. Total - 1 plover nest (1 new)

Gavins Point Reach: The river was surveyed on May 19 & 22 from RM 801 to RM 773. One new plover nest was found at RM 797. Total - 2 plover nests (1 new).

Statistics: 10 plover nests (9 new)

Special Notes:

1. Greg Pavelka, Stacy Adolf, and Corey Loecker mapped habitat using GPS equipment on the Fort Randall Reach from RM 871 to RM 848.

Endangered Species Report

Missouri River Basin - System Summary - May 24 - May 30, 1998

Fort Peck Lake: The lake was not surveyed due to high wind conditions during the week.

Fort Peck River Reach: The upper subsample was not surveyed due to high winds. The lower subsample was surveyed during the week and one least tern was seen.

Lake Sakakawea Reach: One plover was observed on the upper lake but no nests were found. Deepwater, Van Hook and Beaver Creek Bay on the lower lake were surveyed. Two plovers were observed but no new nests were found. Total - 2 plover nests

Garrison Reach: The Missouri was surveyed from 1389 to 1355. No birds of either species were observed.

Lake Oahe Reach: On the Bismarck section the lake from RM 1277 to 1270 was surveyed. Five plovers were seen on Dredge Island (RM 1277) but no nests were found. On the Mobridge section two of the four plover nests found at Kanel Flats last week were lost to unknown causes. On the Pierre section two new plover nests, including one hatched nest were found at Swiftbird. The plover nest found last week at Swiftbird continues to be active. One new plover nest was found at Little Bend.

Total - 5 plover nests (1 hatched, new, 2 lost), 4 plover chicks

Fort Randall Reach: The reach was not surveyed this week.

Lewis & Clark Lake: The mouth of the Niobrara was surveyed on May 29. Three terns and seventeen plovers were seen. The plover nest found last week was abandoned and two new plover nests were found. Lewis & Clark Lake was not surveyed during the week. Total - 2 plover nests (2 new, 1 abandoned)

Gavins Point Reach: The Missouri was surveyed on May 23-26 from RM 807-790 & RM 773-753. New plover nests were found at RM 804.5, 803.5, and 790. Total - 5 plover nests (3 new).

Statistics: 14 plover nests (1 hatched, 8 new, 2 destroyed, 1 abandoned) 4 plover chicks

Special Notes: No special notes for this week.

Endangered Species Report

Missouri River Basin - System Summary - June 28 - July 4, 1998

Fort Peck Lake: The lake was surveyed on June 30. Results are as follows.

Beach 1 - 0 plover nests (1 destroyed flooding)

Beach 5 - no plover adults or chicks observed

Beach 37 - 0 tern nests (1 fate unknown) 2 dead tern chicks found

Total - 0 plover nests (1 destroyed) 0 plover chicks, 0 tern nests (1 fate unknown) 0 tern chicks

Adult Census Completed: 4 plovers and 4 terns

Fort Peck River Reach: The upper subsample was surveyed on June 29 & 30. The lower subsample was surveyed on June 30. Results are as follows.

RM 1712.5 - 1 tern nest

RM 1689.9 - 4 tern nests

RM 1685.7 - 0 tern nests (1 fate unknown)

RM 1674.8 - 0 tern nests (1 hatched) 2 tern chicks

RM 1580.5 - 1 plover nest, 3 tern nests

Total - 1 plover nest, 8 tern nests (1 hatched 1 fate unknown)

Adult Census Completed: 3 plovers and 26 terns

Lake Sakakawea Reach: The lake was surveyed from June 29 - July 2. Results are as follows.

Lake Jessie - 0 plover nests (1 new 1 hatched) 1 tern nest (1 hatched 4 fate unknowns)

Little Egypt - 1 plover nest

White Earth - 5 plover chicks

Tobacco Garden - 1 plover nest 4 plover chicks 4 fledged plover juveniles, 0 tern nests (2 hatched), 1 tern chick

Beacon Island - 4 plover chicks - last week's results

Antelope Flats - 4 plover chicks - last week's results

Van Hook Islands - 3 plover chicks - last week's results

Little Field Bay - 1 plover chick, 1 tern nest - last week's results

Parshall Bay - 1 plover nest 3 plover chicks - last week's results

Deepwater Bay - 3 plover nests - last week's results

Independence Point - 1 plover chick - last week's results

Nishu Bay - 1 plover nest (2 new 2 hatched) 5 plover chicks

Douglas Creek Bay - 2 plover nests 7 plover chicks - last week's results

Fort Stevenson - 1 plover chick

Steinke Bay - 1 plover nest (4 new 6 hatched 1 destroyed 2 fate unknown) 18 plover chicks

Mallard Island - 1 plover nest (6 new 5 hatched) 9 plover chicks

Lake Audubon - 1 plover nest (1 new)

Total - 12 plover nests (14 new, 14 hatched 1 destroyed 2 fate unknown) 62 plover chicks 4 fledged plover juveniles, 2 tern nests (3 hatched 4 fate unknown) 1 tern chick

Adult Census Completed: 87 plovers and 22 terns

Garrison Reach: The upper reach (RM 1389 - 1355) was not surveyed this week. The lower reach (RM 1355-1301) was surveyed on June 29, June 30 & July 1. Results are as follows:

RM 1377.4 - 1 plover nest

RM 1370.0 - 1 plover nest, 6 tern nests 3 tern chicks

RM 1366.0 - 1 tern nest

RM 1362.0 - 4 plover nests, 6 tern nests

RM 1349.7 - 2 plover nests, 1 tern nest (5 hatched) 5 tern chicks

RM 1347.4 - 1 plover nest, 1 tern nest (3 hatched) 1 tern chick

RM 1339.1 - 1 plover nest, 0 tern nests (1 fate unknown)

RM 1334.2 - 1 plover nest (1 new) 3 tern nests (2 new 5 hatched 1 abandoned) 7 tern chicks

RM 1324.5 - 1 plover nest, 0 tern nests (1 hatched 1 fate unknown) 3 tern chicks

RM 1321.1 - 2 tern nests

RM 1319.5 - 3 plover nests (1 new 1 abandoned), 4 tern nests (1 hatched) 1 tern chick

RM 1310.0 - 2 plover nests, 1 tern nest (2 hatched 1 destroyed) 5 tern chicks

RM 1307.3 - 0 plover nests (1 hatched) 3 plover chicks, 0 tern nests (1 hatched)

RM 1302.3 - 0 plover nests (2 new 2 hatched) 5 plover chicks, 3 tern nests (4 new 1 hatched) 2 tern chicks

Total - 17 plover nests (4 new 3 hatched 1 abandoned) 8 plover chicks 26 tern nests (6 new 19 hatched 1 destroyed 2 fate unknown 1 abandoned) 27 tern chicks

Adult Census not completed.

Lake Oahe Reach: The lake was surveyed from June 29 - July 2. Results are as follows:

RM 1299.0 - 0 tern nests (1 hatched) 3 tern chicks

RM 1295.3 - 1 plover nest (1 new) 2 tern nests (2 new 1 hatched) 2 tern chicks

RM 1294.8 - 1 plover nest (1 new) 0 tern nests (1 new 1 hatched) 2 tern chicks

RM 1289.3 - 1 plover nest (1 new 1 fate unknown) 2 tern nests

RM 1270.0 - 5 plover chicks

RM 1251.2 (W) - 2 plover chicks 2 fledged plover juveniles, 3 tern nests 1 tern chick

RM 1251.2 (E) - 0 plover nests (1 hatched), 2 tern nests (1 fate unknown)

RM 1227.3 - 1 plover chick

RM 1190.3 - 1 plover chick

RM 1190.1 - 1 plover nest

Swiftbird - 0 plover nests 6 plover chicks, 3 tern nests - last week's results, not surveyed

Mission Island - 0 tern nests (3 hatched) 4 tern chicks

Mission Point - 1 plover nest (1 destroyed - cattle)

Little Bend - 6 fledged plover juveniles, 1 tern nest

Cheyenne River - 2 fledged plover juveniles, 5 tern nests (1 hatched 1 destroyed)

Dry Creek - 3 plover chicks - last week's results, not surveyed

Plum Creek - 1 tern nest - last week's results, not surveyed

Total - 5 plover nests (3 new 2 hatched 1 destroyed) 18 plover chicks 10 fledged plover juveniles, 19 tern nest (3 new 7 hatched 1 destroyed 1 fate unknown) 12 tern chicks

Adult Census not completed.

Fort Randall Reach: The Missouri was surveyed on July 1. Results are as follows

RM 869.0 - 1 plover nest, 1 tern nest

RM 866.5 - 1 plover nest, 3 tern nests (5 hatched) 4 tern chicks
RM 866.0 - 1 plover nest (1 new) 2 tern nests
RM 851.7 - 1 plover nest, 3 tern nests
RM 851.5 - 5 plover nests, 12 tern nests (1 new)
RM 848.0 - 4 plover chicks, 4 tern nests
Total - 9 plover nests (1 new) 4 chicks, 25 tern nests (1 new 5 hatched)
Adult Census Completed: 31 plovers and 64 terns

Lewis & Clark Lake: The mouth of the Niobrara was surveyed on July 2. Lewis & Clark Lake was surveyed on June 29 & 30. Results are as follows:

Niobrara - 1 plover nest
RM 843.0 - 0 plover nests (1 new 1 hatched) 4 plover chicks
RM 842.0 - 4 plover nests (1 new 1 hatched), 0 tern nests (5 hatched 2 abandoned) 10 tern chicks
RM 841.5 - 8 plover nests (5 new 1 hatched) 33 plover chicks, 5 tern nests (1 new 13 hatched) 21 tern chicks
RM 838.5 - 4 plover nests (2 new 1 hatched 1 abandoned), 8 tern nests (3 new 14 hatched 1 abandoned) 18 tern chicks
RM 836.2 - 0 plover nests (1 new 1 hatched) 3 plover chicks
RM 836.0 - 1 plover nest (1 hatched) 3 plover chicks
RM 831.8 - 1 plover nest (1 new), 6 tern nests (6 new)
RM 830.4 - 0 plover nests (1 new 1 hatched) 3 plover chicks
Total - 19 plover nests (13 new 7 hatched 1 abandoned) 46 plover chicks, 19 tern nests (10 new 32 hatched 3 abandoned) 49 tern chicks
Adult Census Completed: 79 plovers and 109 terns

Gavins Point Reach: The Missouri was not surveyed this week. (See special notes.) Results are from last week's surveys.

RM 804.5 - 3 plover nests)
RM 803.5 - 1 plover chick
RM 799.0 - 7 tern nests 3 tern chicks
RM 797.0 - 1 plover chick
RM 790.0 - 1 plover nest, 2 tern nests
RM 789.0 - 1 plover nest, 4 tern nests 6 tern chicks
RM 781.5 - 1 plover nest, 5 tern nests 3 tern chicks
RM 781.0 - 4 tern nests
RM 777.8 - 2 tern nests
RM 777.5 - 3 plover chicks, 1 tern nest 4 tern chicks
RM 775.0 - 2 plover nests, 2 tern nests
RM 771.0 - 1 plover nest
RM 770.5 - 1 plover nest
RM 770.0 - 1 plover nest, 3 tern nests
RM 776.0 - 1 plover chick, 5 tern nests
RM 760.0 - 3 tern chicks
RM 756.0 - 2 plover chicks, 7 tern nests 1 tern chick

Total - 11 plover nests 8 plover chicks, 42 tern nests 20 tern chicks

Adult Census Completed: 43 plovers, 130 terns

Statistics: 74 plover nests (35 new 26 hatched 2 destroyed 2 abandoned) 146 plover chicks, 25 fledged plover juveniles, 151 tern nests (20 new 67 hatched 2 destroyed 9 fate unknown 4 abandoned) 109 tern chicks

Special Notes:

1. Four plover eggs were collected from a nest at RM 804.5. The eggs are now being incubated at the Captive Rearing Facility at the Gavins Point Project. The fifteen plover chicks being reared at the captive rearing facility continue to do fine.
2. One plover nest at RM 841 and two tern nests at RM 851 have less than 18 inches elevation above the river.
3. Nesting sites on the Missouri River below Fort Randall and Gavins Point were signed and roped off by crews from the Fort Randall and Gavins Point Projects in anticipation of the July 4 weekend.
4. Nesting sites from RM 852 to RM 835 were monitored during the July 4 weekend by personnel from the Omaha District T&E section, the U.S. Fish & Wildlife Service, and the South Dakota Game & Fish Department. No incidents were observed.

Endangered Species Report

Missouri River Basin - System Summary - July 19 - July 25, 1998

Fort Peck Lake: The lake was surveyed on July 23. No birds of either species were observed and no nests were found.

Fort Peck River Reach: The upper subsample was surveyed on July 20 & 21. The lower subsample was surveyed on July 22. Results are as follows.

RM 1712.5 - 1 tern chicks

RM 1689.9 - 5 tern chicks

RM 1682.2 - 0 tern chicks

RM 1674.8 - 0 plover nests (1 hatched) 2 plover chicks, 3 fledged tern juveniles

RM 1580.5 - 1 plover nest, 3 tern chicks

Total - 1 plover nest (1 hatched) 2 plover chicks, 9 tern chicks 3 fledged tern juveniles

Total fledged for reach: 0 plovers & 3 terns

Lake Sakakawea Reach: The lake was surveyed from July 22-24. Results are as follows.

Lake Jessie - 1 plover nest 4 plover chicks, 7 tern nests (1 new) 3 tern chicks

Little Egypt - 0 plover nests (1 hatched) 4 plover chicks

Tobacco Garden - 4 fledged plover juveniles, 5 fledged tern juveniles

Little Field Bay - 3 plover chicks, 2 fledged tern juveniles

Deepwater Bay - 4 plover chicks 3 fledged plover juveniles

Van Hook, Fox Island - 0 plover nests (1 new 1 hatched) 4 plover chicks, 1 tern nest (1 new)

Fort Stevenson - 1 fledged plover juvenile

Steinke Bay - 1 plover nest 3 fledged plover juveniles

Lake Audubon - 7 plover chicks

Total - 2 plover nests (1 new 2 hatched) 26 plover chicks 11 fledged plover juveniles, 8 tern nests (2 new) 3 tern chicks 7 fledged tern juveniles

Total fledged for reach: 72 plovers & 7 terns

Garrison Reach: The upper reach (RM 1389 - 1355) was surveyed on July 22. The lower reach (RM 1355-1301) was surveyed on July 20 & 21. Results are as follows:

RM 1377.4 - 0 plover nests (1 hatched) 3 plover chicks

RM 1370.0 - 4 plover chicks, 3 tern chicks 3 fledged tern juveniles

RM 1364.3 - 1 plover nest (2 new 1 hatched) 3 plover chicks

RM 1362.0 - 2 plover nests, (1 hatched) 9 plover chicks, 0 tern nests (1 hatched) 3 tern chicks 5 fledged tern juveniles

RM 1358.0 - 1 plover nest (1 hatched) 13 plover chicks, 4 fledged tern juveniles

RM 1349.7 - 1 plover nest (1 hatched) 8 plover chicks, 5 fledged tern juveniles

RM 1347.4 - 1 plover nest, 4 fledged tern juveniles

RM 1334.2 - 1 plover nest, 0 tern nests (1 destroyed) 5 fledged tern juveniles

RM 1327.7 - 1 plover nest

RM 1324.5 - 0 plover chicks, 5 fledged tern juveniles

RM 1321.1 - 1 plover nest, 6 fledged tern juveniles

RM 1319.5 - 1 plover nest (2 new 5 hatched) 3 plover chicks, 0 tern nests (1 abandoned) 1 fledged tern juvenile
RM 1310.0 - 1 plover nest
RM 1307.3 - 3 fledged plover juveniles
RM 1302.3 - 1 tern chick
Total - 11 plover nests (3 new 4 hatched) 43 plover chicks 3 fledged plover juveniles, 0 tern nests (1 hatched 1 destroyed) 7 tern chicks 38 fledged tern juveniles
Total fledged for reach: 3 plovers & 52 terns

Lake Oahe Reach: The lake was surveyed on July 20-21. Results are as follows:

RM 1299.0 - 0 tern chicks
RM 1295.3 - 0 plover chicks, 0 tern chicks
RM 1294.8 - 1 plover nest, 1 tern nest
RM 1289.3 - 1 plover nest, 0 tern chicks
RM 1285.0 - 0 tern nests (1 hatched) 2 tern chicks
RM 1251.2 (W) - 0 plover chicks, 0 tern nests (1 destroyed 1 fate unknown)
RM 1251.2 (E) - 0 plover chicks, 0 tern chicks
RM 1190.1 - 0 plover nests (1 hatched)
Swiftbird - 2 tern nests 2 tern chicks 9 fledged tern juveniles
Mission Island - 6 fledged tern juveniles
Mission Point - 4 fledged plover juveniles
Cheyenne River - 4 tern nests (3 hatched) 2 tern chicks 4 fledged tern juveniles
Dry Creek - 4 fledged plover juveniles
Plum Creek - 1 fledged tern juveniles
Total - 2 plover nests (1 hatched) 0 plover chicks 8 fledged plover juveniles, 7 tern nests (4 hatched 1 destroyed 1 fate unknown) 6 tern chicks 20 fledged tern juveniles
Total fledged for reach: 49 plovers & 24 terns

Fort Randall Reach: The Missouri was surveyed on July 22. Results are as follows

RM 869.0 - 0 plover nests (1 hatched), 0 tern chicks
RM 866.5 - 3 plover chicks, 2 tern nests 3 tern chicks 4 fledged tern juveniles
RM 866.0 - 0 plover nests (1 hatched) 3 plover chicks
RM 851.7 - 4 plover chicks, 2 tern chicks
RM 851.5 - 0 plover nests (1 hatched 1 destroyed) 3 plover chicks, 6 tern chicks
RM 848.0 - 3 fledged plover juveniles, 2 tern chicks
Total - 0 plover nests (3 hatched 1 destroyed) 13 plover chicks 3 fledged plover juveniles, 2 tern nests 13 tern chicks 4 fledged tern juveniles
Total fledged for reach: 4 plovers & 4 terns

Lewis & Clark Lake: Lewis & Clark Lake was surveyed on July 21 & 23. Results are as follows:

RM 842.0 - 1 plover nest (2 hatched) 4 plover chicks
RM 841.5 - 4 plover nests (4 hatched 1 destroyed) 10 plover chicks 23 fledged plover juveniles, 2 tern nests (1 new 3 hatched) 13 tern chicks 30 fledged tern juveniles

RM 839.5 - 4 plover chicks, 0 tern nests (1 abandoned)

RM 838.5 - 1 plover nest (1 hatched) 15 plover chicks, 1 tern nest (1 new 1 hatched) 0 tern chicks 13 fledged tern juveniles

RM 836.2 - 3 fledged plover juveniles

RM 831.8 - 1 plover nest (1 hatched), 1 tern nest 11 tern chicks

RM 829.5 - 1 plover nest

Total - 8 plover nests (8 hatched 1 destroyed) 33 plover chicks 26 fledged plover juveniles, 4 tern nests (2 new 4 hatched) 24 tern chicks, 43 fledged tern juveniles

Total fledged for reach: 44 plovers & 92 terns

Gavins Point Reach: The Missouri was surveyed on July 21-23. Results are as follows

RM 807.0 - 4 plover chicks

RM 804.5 - 6 plover chicks 3 fledged plover juveniles, 0 tern nests (1 hatched)

RM 799.0 - 0 tern nests (1 abandoned) 6 fledged tern juveniles

RM 790.0 - 3 fledged plover juveniles, 1 tern nest (2 hatched) 3 fledged tern juveniles

RM 789.0 - 4 plover chicks, 4 tern chicks 9 fledged tern juveniles

RM 781.5 - 3 plover chicks 2 fledged plover juveniles, 3 tern chicks 13 fledged tern juveniles

RM 781.0 - 3 plover chicks, 5 tern chicks

RM 777.8 - 1 tern chick

RM 777.5 - 3 plover chicks, 0 tern nests (1 hatched) 1 tern chick 4 fledged tern juveniles

RM 776.5 - 1 tern nest (1 new)

RM 771.0 - 4 plover chicks, 1 tern nest

RM 770.5 - 2 plover chicks

RM 770.0 - 4 fledged tern juveniles

RM 768.0 - 1 plover nest

RM 766.0 - 10 tern chicks 5 fledged tern juveniles

RM 756.0 - 1 tern nest 7 tern chicks 15 fledged tern juveniles

Total - 1 plover nest 24 plover chicks 8 fledged plover juveniles, 4 tern nests (1 new 4 hatched 1 abandoned) 21 tern chicks 59 fledged tern juveniles

Total fledged for reach: 23 plovers & 105 terns

Adult Census Completed: 43 plovers, 130 terns

Weekly Statistics: 25 plover nests (4 new 18 hatched 2 destroyed) 143 plover chicks, 59 fledged plover juveniles, 25 tern nests (5 new 13 hatched 2 destroyed 1 fate unknown 1 abandoned) 73 tern chicks 174 fledged tern juveniles

Total fledged for the System: 195 plovers & 287 terns

Special Notes:

1. Two plover eggs hatched during the week at the captive rearing facility. There are now four plover eggs incubating and nineteen plover chicks being reared at the captive rearing facility.

2. The lower Niobrara River was surveyed for captive reared plovers on July 24. No captive reared plovers were observed.

Endangered Species Report

Missouri River Basin - System Summary - July 26 - August 1, 1998

Fort Peck Lake: No birds of either species were observed and no nests were found.

Fort Peck River Reach: The upper subsample was surveyed on July 27 & 28. The lower subsample was surveyed on July 30. Results are as follows.

RM 1712.5 - 3 fledged tern juveniles

RM 1689.9 - 9 fledged tern juveniles

RM 1674.8 - 0 plover chicks

RM 1580.5 - 0 plover nests (1 hatched), 1 tern chick

Total - 0 plover nests (1 hatched) 0 plover chicks, 1 tern chick 12 fledged tern juveniles

Total fledged for reach: 0 plovers & 15 terns

Lake Sakakawea Reach: The lake was surveyed from July 27-29 & 31. Results are as follows.

Lake Jessie - 2 plover nests (1 new) 0 plover chicks, 3 tern nests (4 hatched) 0 tern chicks

Little Egypt - 4 plover chicks

Little Field Bay - 0 plover chicks

Deepwater Bay - 4 plover chicks

Van Hook, Fox Island - 2 plover chicks, 0 tern nests (1 hatched) 2 tern chicks

Steinke Bay - 0 plover nests (1 hatched) 1 plover chick

Lake Audubon - 4 plover chicks 3 fledged plover juveniles

Total - 2 plover nests (1 new 1 hatched) 15 plover chicks 4 fledged plover juveniles, 3 tern nests (5 hatched) 2 tern chicks

Total fledged for reach: 76 plovers & 7 terns

Garrison Reach: The upper reach (RM 1389 - 1355) was surveyed on July 30. The lower reach (RM 1355-1301) was surveyed on July 27 & 29. Results are as follows:

RM 1377.4 - 2 plover chicks

RM 1370.0 - 3 plover chicks 4 fledged plover juveniles, 2 tern chicks 8 fledged tern juveniles

RM 1364.3 - 0 plover nests (1 fate unknown) 3 fledged plover juveniles

RM 1362.0 - 0 plover nests, (2 hatched) 7 plover chicks

RM 1358.0 - 0 plover nests (1 hatched) 4 plover chicks 7 fledged plover juveniles, 4 fledged tern juveniles

RM 1349.7 - 1 plover nest 4 plover chicks 4 fledged plover juveniles

RM 1347.4 - 1 plover nest

RM 1334.2 - 0 plover nests (1 hatched) 4 plover chicks

RM 1327.7 - 0 plover nests (1 hatched)

RM 1324.5 - 4 fledged plover juveniles

RM 1321.1 - 1 plover nest

RM 1319.5 - 0 plover nests (1 hatched) 6 plover chicks, 4 fledged plover juveniles

RM 1310.0 - 0 plover nests (1 destroyed) 4 plover chicks, 3 fledged tern juveniles

RM 1302.3 - 2 plover chicks, 7 fledged tern juveniles

Total - 3 plover nests (6 hatched 1 destroyed 1 fate unknown) 36 plover chicks 26 fledged plover juveniles, 2 tern chicks 22 fledged tern juveniles
Total fledged for reach: 29 plovers & 74 terns

Lake Oahe Reach: The lake was surveyed on July 28-29. Results are as follows:

RM 1295.3 - 1 fledged tern juvenile
RM 1294.8 - 0 plover nests (1 hatched) 4 plover chicks 1 fledged plover juvenile, 0 tern nests (1 hatched) 1 tern chick 1 fledged tern juvenile
RM 1289.3 - 1 plover nest, 4 fledged tern juveniles
RM 1285.0 - 2 plover chicks
RM 1251.2 (W) - 4 fledged tern juveniles
RM 1251.2 (E) - 3 fledged tern juveniles
Swiftbird - 0 tern nests (2 hatched) 2 tern chicks 5 fledged tern juveniles
Cheyenne River - 1 tern nest (3 hatched) 9 tern chicks 2 fledged tern juveniles
Total - 1 plover nests (1 hatched) 6 plover chicks 1 fledged plover juvenile, 1 tern nest (6 hatched) 12 tern chicks 20 fledged tern juveniles
Total fledged for reach: 50 plovers & 44 terns

Fort Randall Reach: The Missouri was surveyed on July 29. Results are as follows

RM 869.0 - 0 plover chicks, 0 tern chicks
RM 866.5 - 0 plover chicks, 0 tern nests (2 hatched) 0 tern chicks
RM 866.0 - 0 plover chicks, 2 fledged tern juveniles
RM 851.7 - 2 fledged plover juveniles, 2 fledged tern juveniles
RM 851.5 - 8 plover chicks 8 fledged plover juveniles
RM 848.0 - 1 tern chick
Total - 8 plover chicks 10 fledged plover juveniles, 0 tern nests (2 hatched) 1 tern chick 4 fledged tern juveniles
Total fledged for reach: 14 plovers & 8 terns

Lewis & Clark Lake: Lewis & Clark Lake was surveyed on July 30. Results are as follows:

RM 842.0 - 0 plover nests (1 hatched) 12 plover chicks
RM 841.5 - 0 plover nests (4 hatched) 19 plover chicks, 0 tern nests (2 hatched) 4 tern chicks 8 fledged tern juveniles
RM 839.5 - 4 plover chicks
RM 838.5 - 0 plover nests (1 new 2 hatched) 8 plover chicks 9 fledged plover juveniles, 0 tern nests (1 new 2 hatched) 2 tern chicks 3 fledged tern juveniles
RM 837.8 - 0 plover nests (1 new 1 hatched) 3 plover chicks
RM 831.8 - 1 plover nest 3 plover chicks, 0 tern nests (1 hatched) 10 tern chicks 5 fledged tern juveniles
RM 829.5 - 0 plover nests (1 hatched) 3 plover chicks
Total - 1 plover nest (2 new 9 hatched) 52 plover chicks 9 fledged plover juveniles, 0 tern nests (1 new 5 hatched) 16 tern chicks, 16 fledged tern juveniles
Total fledged for reach: 53 plovers & 108 terns

Gavins Point Reach: The Missouri was surveyed on July 27-29 & 31. Results are as follows

RM 807.0 - 3 plover chicks

RM 804.5 - 4 plover chicks 2 fledged plover juveniles

RM 799.0 - 6 fledged tern juveniles

RM 790.0 - 1 tern nest (1 new 1 hatched)

RM 789.0 - 4 plover chicks, 3 tern chicks 8 fledged tern juveniles

RM 781.5 - 3 fledged plover juveniles

RM 781.0 - 3 plover chicks, 13 fledged tern juveniles

RM 777.8 - 3 tern chicks

RM 777.5 - 3 plover chicks, 5 tern chicks 2 fledged tern juveniles

RM 776.5 - 0 tern nests (1 hatched)

RM 775.0 - 1 fledged plover juvenile

RM 771.0 - 4 plover chicks, 0 tern nests (1 hatched) 2 tern chicks

RM 770.5 - 2 plover chicks

RM 770.0 - 4 fledged tern juveniles

RM 768.0 - 1 plover nest

RM 766.0 - 4 tern chicks 8 fledged tern juveniles

RM 756.0 - 0 plover nests (1 new 1 hatched) 2 plover chicks, 0 tern nests (1 hatched) 2 tern chicks 3 fledged tern juveniles

Total - 1 plover nest (1 new 1 hatched) 25 plover chicks 6 fledged plover juveniles, 1 tern nest (1 new 4 hatched) 19 tern chicks 44 fledged tern juveniles

Total fledged for reach: 29 plovers & 149 terns

Weekly Statistics: 8 plover nests (4 new 19 hatched 1 destroyed 1 fate unknown) 142 plover chicks, 56 fledged plover juveniles, 5 tern nests (2 new 20 hatched 2) 53 tern chicks 118 fledged tern juveniles

Total fledged for the System: 251 plovers & 405 terns

Special Notes:

1. Four plover eggs hatched on July 24 at the captive rearing facility. Seven captive reared plover juveniles were released on Lewis & Clark Lake at RM 839 during the week. Eight captive reared plover juveniles were released on the Missouri River at RM 781.5 during the week. There are eight plover chicks being reared at the captive rearing facility.

2. Eight naturally reared plover juveniles have been captured and had radio transmitters attached as a part of the plover juvenile survivability study being conducted by the University of Wisconsin.

Endangered Species Report

Missouri River Basin - System Summary - August 2 - August 8, 1998

Fort Peck Lake: Surveys have been completed for the year.

Fort Peck River Reach: The upper subsample was surveyed on August 3 & 4. The lower subsample was surveyed on August 5. Results are as follows.

RM 1674.8 - 0 plover chicks

RM 1580.5 - 2 plover chicks, 4 fledged tern juveniles

Total - 2 plover chicks, 4 fledged tern juveniles

Total fledged for reach: 0 plovers & 19 terns

Lake Sakakawea Reach: The lake was surveyed from August 4 & 6. Results are as follows.

Lake Jessie - 0 plover nests (2 destroyed) 4 plover chicks, 1 tern nest (1 new 1 hatched 2 destroyed) 0 tern chicks

Little Egypt - 4 plover chicks

Deepwater Bay - 0 plover chicks

Van Hook, Fox Island - 0 plover nests (1 new 1 hatched) 1 plover chick 2 fledged plover juveniles, 0 tern nests (1 new 1 hatched) 2 fledged tern juveniles

Steinke Bay - 0 plover chick

Lake Audubon - 0 plover chicks

Total - 0 plover nests (1 new 1 hatched 2 destroyed) 9 plover chicks 2 fledged plover juveniles, 1 tern nest (2 new 2 hatched 2 destroyed) 2 fledged tern juveniles

Total fledged for reach: 78 plovers & 9 terns

Garrison Reach: The upper reach (RM 1389 - 1355) was surveyed on August 5. The lower reach (RM 1355-1301) was surveyed on August 3 & 4. Results are as follows:

RM 1377.4 - 3 plover chicks

RM 1370.0 - 3 fledged plover juveniles, 7 fledged tern juveniles

RM 1364.3 - 2 plover chicks

RM 1362.0 - 3 plover chicks 4 fledged plover juveniles

RM 1358.0 - 4 plover chicks

RM 1349.7 - 0 plover nests (1 hatched) 4 plover chicks 4 fledged plover juveniles

RM 1347.4 - 0 plover nests (1 abandoned)

RM 1334.2 - 1 plover chick

RM 1327.7 - 3 plover chicks

RM 1321.1 - 0 plover nests (1 abandoned)

RM 1319.5 - 4 plover chicks

RM 1310.0 - 0 plover chicks, 0 tern nests (1 new 1 hatched) 1 tern chick

RM 1302.3 - 0 plover chicks

Total - 0 plover nests (1 hatched 2 abandoned) 24 plover chicks 11 fledged plover juveniles, 0 tern nests (1 new 1 hatched) 1 tern chick 7 fledged tern juveniles

Total fledged for reach: 40 plovers & 81 terns

Lake Oahe Reach: The lake was surveyed on August 3 & 5. Results are as follows:

RM 1294.8 - 2 plover chicks, 1 tern chick

RM 1289.3 - 1 plover nest

RM 1285.0 - 0 plover chicks

Swiftbird - 2 tern chicks

Cheyenne River - 0 tern nests (1 hatched) 5 tern chicks 8 fledged tern juveniles

Total - 1 plover nest 2 plover chicks, 0 tern nests (1 hatched) 6 tern chicks 8 fledged tern juveniles

Total fledged for reach: 50 plovers & 52 terns

Fort Randall Reach: The Missouri was surveyed on August 6. Results are as follows

RM 869.0 - 2 plover chicks, 0 tern chicks

RM 866.5 - 0 plover chicks, 0 tern chicks

RM 866.0 - 0 plover chicks, 2 fledged tern juveniles

RM 851.5 - 1 plover chick, 11 fledged tern juveniles

RM 848.0 - 0 tern chicks

Total - 3 plover chicks, 13 fledged tern juveniles

Total fledged for reach: 14 plovers & 21 terns

Lewis & Clark Lake: Lewis & Clark Lake was surveyed on August 6. Results are as follows:

RM 842.0 - 8 plover chicks 3 fledged plover juveniles

RM 841.5 - 11 plover chicks 6 fledged plover juveniles, 4 tern chicks 4 fledged tern juveniles

RM 839.5 - 4 fledged plover juveniles

RM 838.5 - 12 plover chicks, 0 tern nests (2 new 2 hatched) 3 tern chicks 3 fledged tern juveniles

RM 837.8 - 3 plover chicks

RM 831.8 - 0 plover nests (1 hatched) 5 plover chicks, 0 tern nests (1 new 1 hatched) 6 tern chicks 7 fledged tern juveniles

RM 829.5 - 3 plover chicks

Total - 0 plover nests (1 hatched) 42 plover chicks 13 fledged plover juveniles, 0 tern nests (3 new 3 hatched) 13 tern chicks, 14 fledged tern juveniles

Total fledged for reach: 68 plovers & 122 terns

Gavins Point Reach: The Missouri was surveyed on August 5-7. Results are as follows

RM 807.0 - 3 plover chicks

RM 804.5 - 4 plover chicks, 2 fledged tern juveniles

RM 799.0 - 2 fledged tern juveniles

RM 790.0 - 0 tern nests (1 abandoned)

RM 789.0 - 4 fledged plover juveniles, 3 fledged tern juveniles

RM 781.5 - 1 fledged tern juvenile

RM 781.0 - 3 plover chicks

RM 777.8 - 4 fledged tern juveniles

RM 777.5 - 3 fledged plover juveniles, 5 fledged tern juveniles

RM 776.5 - 0 tern chicks

RM 771.0 - 4 fledged plover juveniles, 2 tern chicks

RM 770.5 - 2 plover chicks

RM 768.0 - 0 plover nests (1 infertile eggs)

RM 756.0 - 2 plover chicks, 2 tern chicks

Total - 0 plover nests (1 infertile) 14 plover chicks 11 fledged plover juveniles, 0 tern nests (1 abandoned) 4 tern chicks 17 fledged tern juveniles

Total fledged for reach: 39 plovers & 156 terns

Weekly Statistics: 1 plover nest (1 new 3 hatched 2 destroyed 1 infertile 2 abandoned) 96 plover chicks, 37 fledged plover juveniles, 1 tern nest (6 new 7 hatched 2 destroyed 1 abandoned) 24 tern chicks 65 fledged tern juveniles

Total fledged for the System: 293 plovers & 460 terns

Special Notes:

1. Eight plover chicks continue to be reared at the captive rearing facility.

Endangered Species Report

Missouri River Basin - System Summary - August 9 - August 15, 1998

Fort Peck Lake: Surveys have been completed for the year.

Fort Peck River Reach: The lower subsample was surveyed on August 12. Results are as follows.

RM 1580.5 - 0 plover chicks

Total - 0 plover chicks

Total fledged for reach: 0 plovers & 19 terns

Lake Sakakawea Reach: The lake was surveyed from August 11-13. Results are as follows.

Lake Jessie - 4 fledged plover juveniles, 0 tern nests (1 fate unknown) 3 fledged tern juveniles

Little Egypt - 0 plover chicks

Van Hook, Fox Island - 1 plover chick

Deepwater Bay - 1 fledged plover juvenile

Total - 1 plover chick 5 fledged plover juveniles, 0 tern nests (1 fate unknown) 3 fledged tern juveniles

Total fledged for reach: 83 plovers & 12 terns

Garrison Reach: The upper reach (RM 1389 - 1355) was surveyed on August 10. The lower reach (RM 1355-1301) was surveyed on August 10 & 11. Results are as follows:

RM 1377.4 - 3 plover chicks

RM 1364.3 - 2 fledged plover juveniles, 2 fledged tern juveniles

RM 1362.0 - 3 plover chicks

RM 1358.0 - 4 fledged plover juveniles

RM 1349.7 - 4 plover chicks

RM 1334.2 - 0 plover chicks

RM 1327.7 - 3 plover chicks

RM 1319.5 - 6 plover chicks

RM 1310.0 - 2 fledged plover juveniles

RM 1302.3 - 1 fledged plover juvenile

Total - 19 plover chicks 9 fledged plover juveniles, 2 fledged tern juveniles

Total fledged for reach: 49 plovers & 83 terns

Lake Oahe Reach: The lake was surveyed on August 11 & 12. Results are as follows:

RM 1295.3 - 4 fledged tern juveniles

RM 1294.8 - 2 plover chicks

RM 1289.3 - 0 plover nests (1 abandoned)

Swiftbird - 2 fledged tern juveniles

Cheyenne River - 9 fledged tern juveniles

Total - 0 plover nests (1 abandoned) 2 plover chicks, 15 fledged tern juveniles

Total fledged for reach: 50 plovers & 67 terns

Fort Randall Reach: The Missouri was surveyed on August 12. Results are as follows

RM 869.0 - 0 plover chicks

RM 866.5 - 2 fledged plover juveniles

RM 866.0 - 1 fledged plover juvenile

RM 851.5 - 7 fledged plover juveniles, 11 fledged tern juveniles

RM 848.0 - 1 fledged tern juvenile

Total - 10 fledged plover juveniles, 12 fledged tern juveniles

Total fledged for reach: 35 plovers & 25 terns

Lewis & Clark Lake: Lewis & Clark Lake was surveyed on August 12. Results are as follows:

RM 842.0 - 2 plover chicks 3 fledged plover juveniles

RM 841.5 - 1 plover chick 10 fledged plover juveniles, 0 tern nests (2 new 2 hatched) 3 tern chicks 4 fledged tern juveniles

RM 838.5 - 3 plover chicks 6 fledged plover juveniles, 0 tern nests (2 new 2 hatched) 1 tern chick 5 fledged tern juveniles

RM 837.8 - 0 plover chicks

RM 831.8 - 5 plover chicks, 2 tern chicks 3 fledged tern juveniles

RM 829.5 - 3 plover chicks

Total - 14 plover chicks 19 fledged plover juveniles, 0 tern nests (4 new 4 hatched) 6 tern chicks, 12 fledged tern juveniles

Total fledged for reach: 87 plovers & 144 terns

Gavins Point Reach: The Missouri was surveyed on August 11, 13 & 14. Results are as follows

RM 807.0 - 3 fledged plover juveniles

RM 804.5 - 2 fledged plover juveniles

RM 790.0 - 2 fledged tern juveniles

RM 781.0 - 3 fledged plover juveniles

RM 771.0 - 1 fledged tern juvenile

RM 770.5 - 2 fledged plover juveniles

RM 766.0 - 4 fledged tern juveniles

RM 756.0 - 2 plover chicks, 0 tern nests (1 new 1 hatched) 1 tern chick 2 fledged tern juveniles

Total - 2 plover chicks 10 fledged plover juveniles, 0 tern nests (1 new 1 hatched) 1 tern chick 9 fledged tern juveniles

Total fledged for reach: 49 plovers & 165 terns

Weekly Statistics: 0 plover nests (1 abandoned) 38 plover chicks, 53 fledged plover juveniles, 0 tern nests (5 new 5 hatched 1 fate unknown) 7 tern chicks 53 fledged tern juveniles

Total fledged for the System: 346 plovers & 513 terns

Special Notes:

1. Eight plover chicks continue to be reared at the captive rearing facility.
2. Nest sites on the Missouri River below Gavins Point Dam were GPSed.
3. A mistake on my part placed 11 fledged plovers in the fledged tern category for Fort Randall

Endangered Species Report

Missouri River Basin - System Summary - August 16 - August 22, 1998

Fort Peck Lake: Surveys have been completed for the year.

Fort Peck River Reach: The river was surveyed on August 20. Results are as follows.

RM 1580.5 - 2 fledged plover juveniles

Total - 2 fledged plover juveniles

Surveys have been completed on the Fort Peck River Reach for the year.

Total fledged for reach: 2 plovers & 19 terns

Lake Sakakawea Reach: The lake was surveyed from August 18. Results are as follows.

Van Hook, Fox Island - 1 fledged plover juvenile, 2 fledged tern juveniles

Total - 1 fledged plover juvenile, 2 fledged tern juveniles

Surveys have been completed on Lake Sakakawea for the year.

Total fledged for reach: 84 plovers & 14 terns

Garrison Reach: The upper reach (RM 1389 - 1355) was surveyed on August 17. The lower reach (RM 1355-1301) was surveyed on August 17 & 18. Results are as follows:

RM 1377.4 - 3 fledged plover juveniles

RM 1362.0 - 3 fledged plover juveniles

RM 1349.7 - 3 plover chicks

RM 1334.2 - 3 fledged plover juveniles

RM 1327.7 - 3 plover chicks

RM 1319.5 - 1 plover chick 3 fledged plover juveniles

Total - 7 plover chicks 12 fledged plover juveniles

Total fledged for reach: 61 plovers & 83 terns

Lake Oahe Reach: The lake was surveyed on August 18. Results are as follows:

RM 1294.8 - 4 plover chicks

Total - 4 plover chicks

Total fledged for reach: 50 plovers & 67 terns

Fort Randall Reach: The Missouri was surveyed on August 18. Results are as follows

RM 869.0 - 0 plover chicks

Surveys have been completed on the Fort Randall Reach for the year.

Total fledged for reach: 35 plovers & 25 terns

Lewis & Clark Lake: Lewis & Clark Lake was surveyed on August 19 & 20. Results are as follows:

RM 842.0 - 3 fledged plover juveniles

RM 841.5 - 3 fledged tern juveniles

RM 838.5 - 3 fledged plover juveniles, 1 fledged tern juvenile

RM 837.8 - 3 fledged plover juveniles

RM 831.8 - 2 plover chicks 3 fledged plover juveniles, 2 fledged tern juveniles

RM 829.5 - 2 fledged plover juveniles

Total - 2 plover chicks 14 fledged plover juveniles, 6 fledged tern juveniles

Total fledged for reach: 101 plovers & 150 terns

Gavins Point Reach: The Missouri was surveyed on August 21. Results are as follows

RM 756.0 - 2 fledged plover juveniles

Total - 2 fledged plover juveniles

Surveys have been completed on the Gavins Point Reach for the year.

Total fledged for reach: 51 plovers & 165 terns

Weekly Statistics: 13 plover chicks, 31 fledged plover juveniles, 0 tern chicks 8 fledged tern juveniles

Total fledged for the System: 378 plovers & 521 terns

Special Notes:

1. Two plover juveniles were released on August 20. Two plover juveniles died during the week at the captive rearing facility. Four plover juveniles continue to be reared at the captive rearing facility.

Endangered Species Report

Missouri River Basin - System Summary - August 23 - August 29, 1998

Fort Peck Lake: Surveys have been completed for the year.

Fort Peck River Reach: Surveys have been completed for the year.
Total fledged for reach: 2 plovers & 19 terns

Lake Sakakawea Reach: Surveys have been completed for the year.
Total fledged for reach: 84 plovers & 14 terns

Garrison Reach: The lower reach (RM 1355-1301) was surveyed on August 24. Results are as follows:

RM 1349.7 - 1 fledged plover juvenile

RM 1327.7 - 3 fledged plover juveniles

RM 1319.5 - 2 fledged plover juveniles

Total - 6 fledged plover juveniles. Surveys have been completed on the Garrison Reach.

Total fledged for reach: 67 plovers & 83 terns

Lake Oahe Reach: The lake was surveyed on August 24. Results are as follows:

RM 1294.8 - 0 plover chicks

Total - 0 plover chicks. Surveys have been completed on Lake Oahe.

Total fledged for reach: 50 plovers & 67 terns

Fort Randall Reach: Surveys have been completed for the year.

Total fledged for reach: 35 plovers & 25 terns

Lewis & Clark Lake: Lewis & Clark Lake was surveyed on August 26. Results are as follows:

RM 831.8 - 2 fledged plover juveniles

Total - 2 fledged plover juveniles. Surveys have been completed on Lewis & Clark Lake.

Total fledged for reach: 103 plovers & 150 terns

Gavins Point Reach: Surveys have been completed for the year.

Total fledged for reach: 51 plovers & 165 terns

Weekly Statistics: 0 plover chicks, 8 fledged plover juveniles

Total fledged for the System: 386 plovers & 521 terns

Special Notes:

1. Four plover juveniles were released on August 25. All captive reared plovers have now been released.

2. This is the final weekly report for the 1998 nesting season.

APPENDIX F

PUBLIC AWARENESS

Date

Programming Director
Omaha radio station
address

Dear (name):

The Corps of Engineers has produced a short (30 second) Public Service Announcement (PSA) for radio use this summer, especially around the July 4 holiday. The PSA was read by Girl Scout Troop 503, fifth grade girls from Our Lady of Lourdes grade school here in Omaha. Several of the girls are working on an endangered species badge and this was something extra to go towards the badge.

The subject of the PSA focuses on avoidance of sandbar islands because these islands are used for nesting and chick-rearing by the least tern (endangered species) and the piping plover (threatened species). A copy of the script is attached.

The PSA's were produced as part of the Corps' implementation of the Biological Opinion issued by the U.S. Fish and Wildlife Service to the Corps. In it, the Corps is requested to increase public awareness of these birds, as well as develop additional habitat and to monitor their populations within the Missouri River basin.

Please let us know (see enclosed form) if you are able to air the enclosed PSA this summer. This same PSA will be used for several summers.

Thank you for your assistance on increasing public awareness of the plight of the least tern and piping plover.

Sincerely,

2 Encls. (script and use form)

KTFC
RT 2, BOX 102-A
SIOUX CITY IA 51106

KSOO (AM)/KPAT (FM)
2600 SPRING AVE
SIOUX FALLS SD 57105

KELO AM-FM
500 S PHILLIPS S
SIOUX FALLS SD

KWSL (AM)/KGLI (FM)
BOX 1737
SIOUX CITY IA 51102

KMNS(AM)/KSEZ (FM)
901 STEUBEN ST
SIOUX CITY, IA 51102

KXRB(AM)/KKL
3205 S MEADOW
SIOUX FALLS SD

WNAX (AM-FM)
1609 E HWY 50
YANKTON SD 57078

KUSD AM-FM
414 E CLARK ST
VERMILLION SD 57069

KNEN (FM)
BOX 937
NORFOLK NE 68

WJAG (AM)
BOX 789
NORFOLK NE 68701

KQDY (FM)/KBMR (AM)
3500 E ROSSER AVE
BISMARCK ND 58501

KCND (FM)
1814 N 14 ST
BISMARCK ND 5

KFYR (AM)
BOX 1738
BISMARCK ND 58502

The following scripted Public Service Announcement (PSA) was sent to the above radio stations:

If your plans include boating on the Missouri River or on the U.S. Army Corps of Engineers lakes on the Fourth of July weekend, the Corps reminds you that many sandbars provide nesting habitat for the interior least tern and piping plover, both of which are protected under the Endangered Species Act. The Corps and the U.S. Fish and Wildlife Service monitor these birds and post the larger nesting islands. Please do your part to help by avoiding islands colonized by the tern and plover. (reading time 30 seconds)

PUBLIC SERVICE DIRECTOR
KFAB
5010 UNDERWOOD
OMAHA NE 68132

PUBLIC SERVICE DIRECTOR
KQKQ
1001 FARNAM ST
OMAHA NE 68102

PUBLIC SERVICE DIRECTOR
KFOR
PO BOX 80209
LINCOLN NE 68501

PUBLIC SERVICE DIRECTOR
WJAG
PO BOX 789
NORFOLK NE 68701

PUBLIC SERVICE DIRECTOR
KOTD
808 BEACON DR
PO BOX 509
PLATTSMOUTH NE 68048

PUBLIC SERVICE DIRECTOR
KKAR
1001 FARNAM ST
OMAHA NE 68102

PUBLIC SERVICE DIRECTOR
KEZO
11128 JOHN GALT BLVD
OMAHA NE 68137

PUBLIC SERVICE DIRECTOR
KLIN
PO BOX 30181
4343 O ST
LINCOLN NE 68503

PUBLIC SERVICE DIRECTOR
KNEN
300 MADISON AVE
NORFOLK NE 68701

PUBLIC SERVICE DIRECTOR
KWPN
1011 N LINCOLN
PO BOX 84
WEST POINT NE 68788

PUBLIC SERVICE DIRECTOR
KESY
4807 DODGE ST
OMAHA NE 68132

PUBLIC SERVICE DIRECTOR
WOW
5030 N 72 ST
OMAHA NE 68134

PUBLIC SERVICE DIRECTOR
KTCH
PO BOX 413
W. HWY 35
WAYNE NE 68787
PUBLIC SERVICE DIRECTOR
KBRX
PO BOX 150
O'NEILL NE 68763

The above radio stations received a taped PSA that was recorded by a Girl Scout Troop from Our Lady of Lourdes Grade School in Omaha, Nebraska. The stations were requested to play the tape throughout the summer, but especially over the fourth of July holiday. The script for the pre-taped PSA is as follows:

Are you spending the weekend on the Platte River or the upper Missouri River? Many river sandbars provide nesting and chick-rearing habitat for endangered bird species. The least tern is an endangered bird. The piping plover is a threatened bird. Both of these birds and their chicks need our help to survive. Several sandbar islands have signs on them asking people to stay off because terns and plovers nest there. Girl Scout Troop 503 and the Corps of Engineers asks you to avoid these nesting areas and help protect our natural heritage.

(recorded time approximately 30 seconds)

Piping Plovers and Least Terns of the Great Plains and Nearby: A Symposium/Workshop

**Feb. 2-5, 1998
Holiday Inn Central-Omaha, NE**

Monday, February 2, 1998

7:00-9:00 p.m. Evening Social and Registration - **Palace Foyer in Holiday Inn**

Tuesday, February 3, 1998

Symposium/Workshop - Holiday Inn Rooms B and C

Plenary Session - Recovery Status

Moderator: Casey D. Kruse

8:15 - 8:30 a.m. Announcements

8:30 - 9:00 a.m. Kirsch, Eileen. INTERIOR POPULATION OF LEAST TERN.

9:00 - 9:30 a.m. Amirault, Diane L. EASTERN CANADA PIPING PLOVERS.

9:30 - 10:00 a.m. Hecht, Anne. U.S. ATLANTIC COAST PIPING PLOVERS.

10:00 - 10:30 a.m. BREAK

10:30 - 11:00 a.m. Cuthbert, Franscesca and Lauren Wemmer. GREAT LAKES
PIPING PLOVERS.

11:00 - 11:30 a.m. McPhillips, Nell. NORTHERN GREAT PLAINS PIPING PLOVERS

11:30 a.m. - 12:50 p.m. LUNCH

Session 1 - Population Trends and Long-term Viability

Moderator: Dr. Scott Lutz

12:50 - 1:00 p.m. Announcements

1:00 - 1:20 p.m. Vilella, Francisco J. MODELING POPULATIONS AND ANALYSIS OF TRENDS FOR THE INTERIOR LEAST TERN FROM SURVEYS IN THE LOWER MISSISSIPPI RIVER: 1984-1995.

1:20 - 1:40 p.m. Plissner, Jonathan and Susan Haig. OVERVIEW OF THE RESULTS OF THE 1996 INTERNATIONAL PIPING PLOVER CENSUS.

1:40 - 2:00 p.m. Kirsch, Eileen M. and Mark Boyce. AFFECTS OF SPREADING RISK ON POPULATION VIABILITY: WHY MAINTAINING A WIDELY DISTRIBUTED INTERIOR LEAST TERN POPULATION AND CRITICAL HABITAT IS IMPORTANT.

2:00 - 2:20 p.m. Plissner, Jonathan and Susan Haig. METAPOPOPULATION VIABILITY OF PIPING PLOVERS IN THE U.S. GREAT PLAINS AND PRAIRIE CANADA.

Session 2 - Status and Conservation of Geo-regional Populations

2:20 - 2:40 p.m. Vilella, Francisco J. ECOLOGICAL ASPECTS AND CONSERVATION STATUS OF THE LEAST TERN IN THE WEST INDIES.

2:40 - 3:00 p.m. Dinsmore, James J., Stephen J. Dinsmore, and Daryl L. Howell. LEAST TERNS AND PIPING PLOVERS IN IOWA: PERSISTENCE OF MARGINAL POPULATIONS.

3:00 - 3:20 p.m. BREAK

Moderator: Lee Elliott

3:20 - 3:40 p.m. Goossen, Paul, Tom Jung, and Bill Aitken. PIPING PLOVER PRODUCTIVITY AND CONSERVATION AT LAKE DIEFENBAKER, SASKATCHEWAN.

3:40 - 4:00 p.m. Szell, Christopher and Mark Woodrey. REPRODUCTIVE PERFORMANCE OF THE INTERIOR LEAST TERN ON THE LOWER MISSISSIPPI RIVER FOR YEARS 1995, 1996, AND 1997.

4:00 - 4:20 p.m. Murphy, Robert K., Michael J. Rabenberg, Marriah L. Sondreal,

Winter L. Smith, Bruce Casler, and Debra A. Guenther. REPRODUCTIVE SUCCESS OF GREAT PLAINS PIPING PLOVERS ON ALKALI LAKES IN NORTHWESTERN NORTH DAKOTA AND NORTHEASTERN MINNESOTA.

4:20 - 4:40 p.m. Houghton, Larry, Jim Fraser, and Susan Elias-Gerken. PIPING PLOVER POPULATION DYNAMICS ON A STORM-DESTROYED AND RE-BUILT BARRIER ISLAND VILLAGE.

4:40 - 5:00 p.m. Adolf, Stacy L., Casey D. Kruse, Kenneth F. Higgins, and Rex R. Johnson. DISTRIBUTION AND PRODUCTIVITY OF INTERIOR LEAST TERNS AND PIPING PLOVERS ALONG THE NIOBRARA RIVER IN NEBRASKA.

Wednesday, February 4, 1998

Session 2 Cont. - Status and Conservation of Geo-regional Populations

Moderator: John Dinan

7:50 - 8:00 a.m. Announcements

8:00 - 8:20 a.m. Pavelka, Greg and Casey Kruse. PIPING PLOVER AND LEAST TERN MANAGEMENT ON THE MISSOURI RIVER.

8:20 - 8:40 a.m. Melvin, Scott. LIMITING FACTORS, MANAGEMENT, AND DEMOGRAPHIC RESPONSES OF PIPING PLOVERS IN MASSACHUSETTS.

8:40 - 9:00 a.m. Fraser, James D., John P. Loegering, Micheal E. Patterson, and Susan E. Gerken. PIPING PLOVER BROOD FORAGING ECOLOGY, HABITAT SELECTION AND SURVIVAL ON ATLANTIC BARRIER ISLANDS.

Session 3 - Habitat Characteristics, Assessment, and Management

9:00 - 9:20 a.m. Speer, Richard T. DEVELOPMENT OF A BLACK SKIMMER AND LEAST TERN NESTING SITE AT BRAZORIA NATIONAL WILDLIFE REFUGE.

9:20 - 9:40 a.m. Plettner, Rockford G., and Jim Jenniges. REPRODUCTIVE SUCCESS OF LEAST TERNS AND PIPING PLOVERS ON MANAGED AND UNMANAGED SAND PITS NEAR THE CENTRAL PLATTE RIVER, NEBRASKA, 1994-1997.

9:40 - 10:00 a.m. Armbruster, Michael J., Tom Parks and Susan Broderick. RIVER MANAGEMENT MODELING - A TOOL TO ASSIST THE BUREAU OF

RECLAMATION TO ENHANCE INTERIOR LEAST TERN AND PIPING
PLOVER HABITAT IN THE UPPER MISSOURI RIVER BASIN, MONTANA.

10:00 - 10:20 a.m. BREAK

Moderator: Arnold Dood

10:20 - 10:40 a.m. Plettner, Rockford G., and Jim Jenniges. REPRODUCTIVE
SUCCESS OF LEAST TERNS AND PIPING PLOVERS ON THREE ARTIFICIAL
ISLANDS ON THE CENTRAL PLATTE RIVER, NEBRASKA, 1991-1997.

10:40 - 11:00 a.m. Nelson, Duane. HABITAT RESTORATION AND CREATION AS A
RECOVERY METHOD FOR COLORADO'S NESTING LEAST TERNS AND
PIPING PLOVERS.

11:00 - 11:20 a.m. Adolf, Stacy L., Casey D. Kruse, Kenneth F. Higgins, and Rex R.
Johnson. NEST SITE SELECTION OF INTERIOR LEAST TERNS AND PIPING
PLOVERS AND USE OF AERIAL VIDEOGRAPHY IN DETERMINING SITE
CHARACTERISTICS.

11:20 - 11:40 a.m. Boyne, Andrew and Diane Amirault. HABITAT
CHARACTERISTICS OF PIPING PLOVER NESTING BEACHES IN NOVA
SCOTIA, NEW BRUNSWICK AND PRINCE EDWARD ISLAND.

11:40 - 12:00 p.m. Cobb, Stephen P. METHODOLOGIES FOR SYSTEM-WIDE
ANALYSES OF LEAST TERN COLONY AND HABITAT TEMPORAL AND
SPATIAL DISTRIBUTIONS ALONG THE MISSISSIPPI RIVER.

12:00 - 1:30 p.m. LUNCH

1:30 - 1:40 p.m. Announcements

1:40 - 2:00 p.m. Laustrop, Mark. MISSOURI RIVER ENVIRONMENTAL
ASSESSMENT PROGRAM UPDATE.

2:00 - 2:20 p.m. Quayle, Brad and Jackie Raspotnik. GIS AND MISSOURI RIVER
SPATIAL APPLICATIONS.

Session 4 - Wintering Issues

Moderator: Diane Amirault

2:20 - 2:40 p.m. Drake, Katherine, Jonathan Thompson, Kiel Drake, Curt Zonick,
and Jeff Rupert. WINTER MOVEMENTS AND SURVIVAL RATES FOR PIPING
PLOVERS.

- 2:40 - 3:00 p.m. Bacak-Clements, Pat. TO BE ANNOUNCED.
- 3:00 - 3:20 p.m. Drake, Kiel, Jonathan Thompson, Katherine Drake, Curt Zonick, and Jeff Rupert. DAILY AND SEASONAL VARIATION IN ROOST SITE CHARACTERISTICS OF WINTERING PIPING (CHARADRIUS MELODUS) AND SNOWY PLOVERS (C. ALEXANDRINUS NIVOSUS).
- 3:20 - 3:40 p.m. BREAK

Session 5 - Enhancing and Assessing Recruitment

- 3:40 - 4:00 p.m. Lutz, Scott, Robyn Niver, Casey Kruse, and Nell McPhillips. A PROPOSAL TO INVESTIGATE PIPING PLOVER SURVIVAL ON THE MISSOURI RIVER.
- 4:00 - 4:20 p.m. Murphy, Robert K., J. Paul Goossen, Karen A. Smith, (Tentatively also: Root, Ryan, Mayer). A PROTOCOL FOR ASSESSING PIPING PLOVER REPRODUCTIVE SUCCESS ON GREAT PLAINS ALKALI LAKES.
- 4:20 - 4:40 p.m. Gordon, Keith and Casey Kruse. NEST RELOCATION - A MANAGEMENT ALTERNATIVE FOR THREATENED NEST SITES.
- 4:40 - 5:00 p.m. Murphy, Robert K. and Raymond J. Greenwood. EFFECTIVENESS OF TEMPORARY, ELECTRIC-MESH, PREDATOR-EXCLUSION FENCING FOR IMPROVING PIPING PLOVER FLEDGING RATES ON GREAT PLAINS ALKALI LAKES.

Thursday, February 5, 1998

Session 6 - Making Recovery a Reality

Moderator: Lou Hanebury

- 8:00 - 8:10 a.m. Announcements
- 8:10 - 8:30 a.m. Dood, Arnold. PIPING PLOVER RECOVERY IN MONTANA: THE GOOD, THE BAD AND THE UGLY.
- 8:30 - 8:50 a.m. Anderson, Julie. TALKING TERNS AND OTHER ENDANGERED SPECIES: HOW TO PITCH YOUR STORY TO THE MEDIA.

- 8:50 - 9:10 a.m. Olson, Mike. THE SOUTHPORT II PROJECT: CAN DEVELOPMENT AND AN ENDANGERED SPECIES CO-EXIST?
- 9:10 - 9:30 a.m. Lingle, Gary, Anne Hecht, John Sidle, Eileen Kirsch. BANDING RELATED LEG INJURIES IN THE PIPING PLOVER.
- 9:30 - 10:00 a.m. BREAK
- 10:00 - 10:20 a.m. Hecht, Anne. ASSATEAGUE ISLAND RESTORATION PROJECT - A CASE STUDY IN INTER-AGENCY CONSULTATION.
- 10:20 - 10:40 a.m. Wemmer, Lauren and Francesca Cuthbert. BANDING PIPING PLOVERS IN THE GREAT LAKES EVALUATION AND NEW INSIGHTS.
- 10:40 - 11:00 a.m. Kruse, Casey and Greg Pavelka. PIPING PLOVER STEW AND OTHER CULINARY DELIGHTS.
- 11:00 - 11:20 a.m. Melvin, Scott and Anne Hecht. FEDERAL SECTION 9 AND STATE REGULATORY GUIDELINES FOR PROTECTING PIPING PLOVERS AND THEIR HABITATS.
- 11:20 - 11:40 a.m. Kruse, Casey and Greg Pavelka. CAPTIVE REARING OF LEAST TERNS AND PIPING PLOVERS.
- 11:40 - 12:00 p.m. Elliott, Lee. EFFECTS OF HUMAN DISTURBANCE ON WINTERING PIPING PLOVERS.
- 12:00 - 12:30 p.m. Closing Remarks and Final Announcements

APPENDIX G

OTHER STUDIES

University of Wisconsin-Madison



Department of Wildlife Ecology

226 Russell Labs, 1630 Linden Drive, Madison WI 53706-1598

Phone: 608-262-2671 FAX: 608-262-6099

<http://www.wisc.edu/wildlife>

School of Natural Resources

College of Agricultural and Life Sciences

October 19, 1998

Mike George
Dept. of Army- COE
Omaha District Operations Division
215 N. 17th St.
Omaha, NE 68102-4978

Dear Mike,

I have completed an annual report documenting my research activities on piping plover survival for the 1998 field season. I have enclosed a copy of this report for your review. If you have any further questions, you can reach me at 608-262-1984.

Sincerely,

Robyn Anne Niver
Graduate Research Assistant
UW-Madison
Enclosure (1)

RECEIVED

OCT 26 1998

CEMRO-OP-TN

**A comparison of captive-reared and wild-
reared piping plover behavior and survival
on the Missouri River**

1998 Progress Report

Prepared by:

Robyn A. Niver
Graduate Research Assistant
University of Wisconsin-Madison

INTRODUCTION

The Great Plains region is bisected northwest to southeast by the Missouri River, which annually supports 200 breeding pairs of piping plovers. The COE operates six water-control structures along the Missouri from Fort Peck, MT to Gavins Point, SD.

Operations of these structures have affected piping plover productivity and survival.

Since 1995, the COE has initiated a salvage program during flood events in which eggs are collected and chicks reared until fledging, when they are returned to the wild.

This study is evaluating the survival of released captive-reared plovers, as well as the survival of wild-reared plovers. Information about piping plover survival and recruitment is important for successful management of the species, however there is a lack of data available on fledgling survival. We are also comparing the behaviors of captive- and wild-reared plovers.

All work was done in accordance with the conditions of the endangered species permit PRT-704930, subpermit 98-06, as well as permits from the South Dakota Department of Game, Fish and Parks, and the Nebraska Game and Parks Commission.

STUDY AREA

The study site was located on the Missouri River in northeastern Nebraska. Piping plover habitat in this reach of the Missouri is typically barren, to sparsely vegetated sandbars ranging in size from <1 to >100 acres. The study area consisted of 98.5 river miles (RM), from Verdel, NE (RM 851.5) to Ponca State Park (RM 753.0), NE. My project focused on two areas of the river, RM 851.0-829.5 and RM 807.0-781.5. Captive rearing took place at the COE facility at Gavins Point, near Yankton, SD.

METHODS

Captive rearing

The COE collected eggs from wild piping plover nests in accordance with US Fish and Wildlife Service (USFWS) collection permit guidelines. We brought the collected eggs back to the captive-rearing facility in portable incubators and incubated the eggs until we observed embryo crowning within the egg or pipping of the shell. Eggs were then placed them into the hatcher of the incubator. After hatching, we marked individual chicks with non-toxic markers and placed them into a wooden brooder box, lined with sand and heated with a heat lamp. Broodmates were kept together in brooder boxes. Chicks were fed a combination of mealworms, insects, wax worms, and crickets an average of three times per day.

The chicks remained in the brooder box until they were able to thermoregulate themselves. They were then placed in an outside flight pen until their release. We banded all chicks with a light blue flag on their right tibiotarsus and a USFWS stainless steel 1A band on their left metatarsus. We distinguished broods with unique color markings applied to the flags.

Survival

The COE conducted surveys from late April to late August to locate nest sites and determine nest and fledging success. Once chicks were observed to be capable of sustaining short flights, we attempted their capture. We experimented with 3 capture techniques: dip nets, mist nets, and noose carpets.

Noose carpets were most effective. The carpet was a 0.72x0.92m piece of hardware cloth with monofilament nooses tied every 6-10cm. We placed lead lines

perpendicular to the water along both sides of the noose carpet, in areas juvenile plovers were observed foraging. The plovers often returned to the site and resumed foraging and were captured. Alternatively, we slowly walked groups of plovers into the capture area. When plovers were captured, we placed them into cloth holding bags and weighed them to 1.0g (Figure 1); any birds $\geq 40.0\text{g}$ were kept for transmitter attachment. Captive-reared plovers were radioed when they weighed $\geq 40.0\text{g}$.



Figure 1. Weighing a wild-reared juvenile piping plover after capture.

Transmitters were 15mm x 7mm x 4mm thick, with a 10cm whip antenna and weighed 1.2g. We clipped feathers along the dorsal feather tract on the lower back and applied a water-resistant epoxy (Titan Corp. #332) to the feather shafts. We also glued a small fiberglass screen to the transmitter to increase the surface area before attachment to the bird. We retained the birds until the epoxy hardened. All captured wild juveniles were banded similar to the captive-reared plovers.

We released captive-reared plovers on sandbars near areas with other wild-reared juveniles (Figure 2) and began monitoring captive-reared and wild-reared plover survival the day following flag attachment and continued until migration or mortality was observed. Visual sightings of radioed birds were attempted every 1-3 days by intensively surveying sandbars.

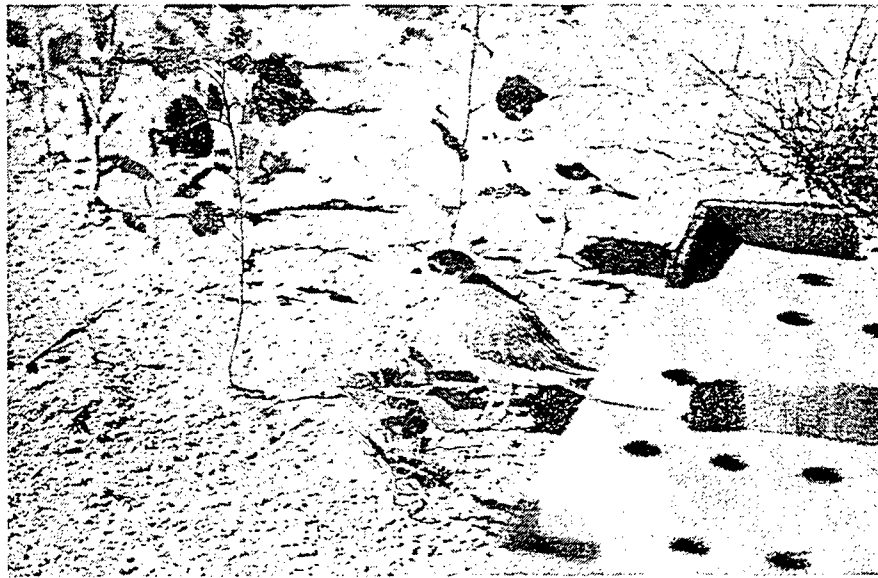


Figure 2. Two piping plovers at the release site

We used the Kaplan-Meier procedure to estimate survival for pre- and post-fledged captive- and wild-reared piping plovers. When birds were censored, we removed them from our survival estimates. We then compared the captive- and wild-reared survival curves using the log-rank test.

Behavior

After chicks hatched in the wild, we began our behavior observations. We observed all chicks in a brood for 30 minutes at 30-second intervals using scan sampling techniques and recorded the frequency of behavior in 7 categories: feeding, preening, resting, alert,

moving, disturbed, and aggressive. We then observed individual chicks for 3 minutes using focal sampling techniques and recorded the frequency and duration of all behaviors. Observations of wild-reared plovers were done from the boat or at the edge of a sandbar with vegetation often concealing us.

We observed captive-reared plovers from hatch to fledging at the captive rearing facility. We only used scan sampling techniques for captive-reared plovers as only one person was needed for this technique and disturbance was kept to a minimum.

RESULTS AND DISCUSSION

Survival

The COE collected 24 piping plover eggs from 6 jeopardized nest sites during 1998. On June 5th, 4 eggs were collected off the Fort Randall reach at both RM 851.7 and 851.9 in an area of intense human activity. On June 17th, 8 eggs were collected off the Lewis and Clark Lake reach at RM 828.4 due to the risk of flooding from increased water releases. On July 2nd 4 eggs were collected off the Gavins Point Reach at RM 804.4 from an area with historically high predation rates. On July 7th 4 eggs were collected off the Lewis and Clark reach at RM 842.2 due to increased water levels.

Twenty-three plover chicks hatched and survived to fledge. One egg was infertile. Twenty-one plovers were released back into the wild and 2 died prior to release in the flight pen. We believe the chlorinated water used to fill the flight pens may have caused these deaths and the plovers will be sent to the USGS/NBS health lab in Madison, WI for analysis. Three plovers were released on July 7th at RM 837.5, 8 were released on July 20th at RM 780.5, 4 were released on July 24th at RM 839.5, 2 were released on August 16th at RM 841.5, and 4 were released on August 25th at RM 836.0. The average

age at release was 33 days (30-36 days). The average weight at release was 43.44g (35.8-49.2g). We relocated captive-reared plovers an average of 5.2 days (0-25 days) after release. We observed 3 mortalities, all believed to have been caused by avian predators.

We captured 14 wild piping plover juveniles and of these, 11 weighed ≥ 40.0 g. We used a dip net for one capture and a noose carpet for the other 13 captures. We released birds after an average of 10.8 minutes. The average weight of captured wild plovers was 41.6g (34.0-48.0g). We relocated wild-reared plovers an average of 10.6 days (2-35 days) after transmitter attachment. We did not observe any mortality of wild-reared plovers at capture sites, although mortalities may have occurred after the plovers began their migration. We did not observe any plover injuries related to the capture methods, radios, or bands.

Our survival information was limited due to transmitter retention. Captive- and wild-reared birds had an average retention time of 5.8 and 7.7 days respectively. This short retention time may be a result of the juvenile plovers still undergoing feather development and fragile blood sheaths may have been cauterized by the heat of the curing epoxy. This may have allowed the birds to pull out the unattached feathers and transmitter. Most survival information was gathered after radio loss by observing flagged birds.

A benefit of using captive rearing for piping plovers is that survival can be increased in the period before fledging. We observed a higher survival rate from day 1 to fledging in the captive-reared birds ($P=0.001$) (Figure 3). We could not evaluate post-fledging survival because of inadequate sample size from dead wild birds (Figure 4). This was likely due to the transmitter retention problem.

1998 Captive- and Wild-reared Piping Plover Pre-fledging Survival

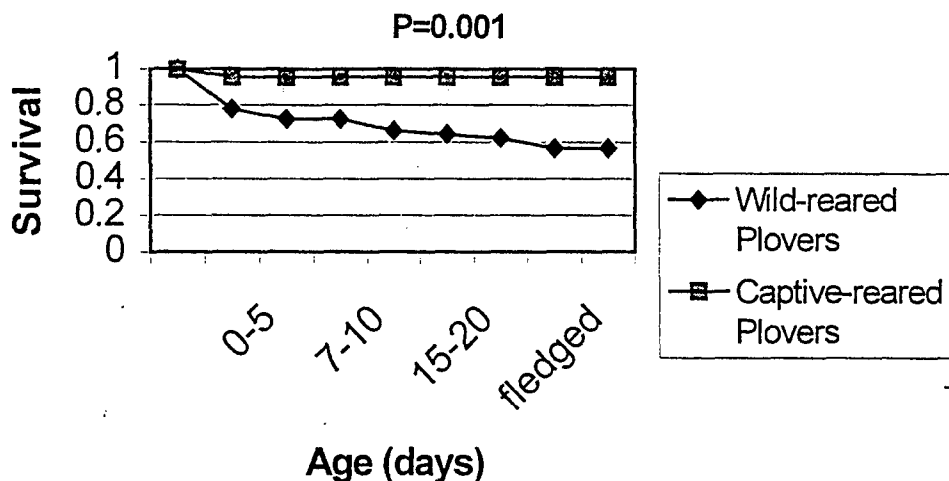


Figure 3. Pre-fledging survival of captive- and wild-reared piping plovers.

1998 Captive- and Wild-reared Piping Plover Post-fledging Survival

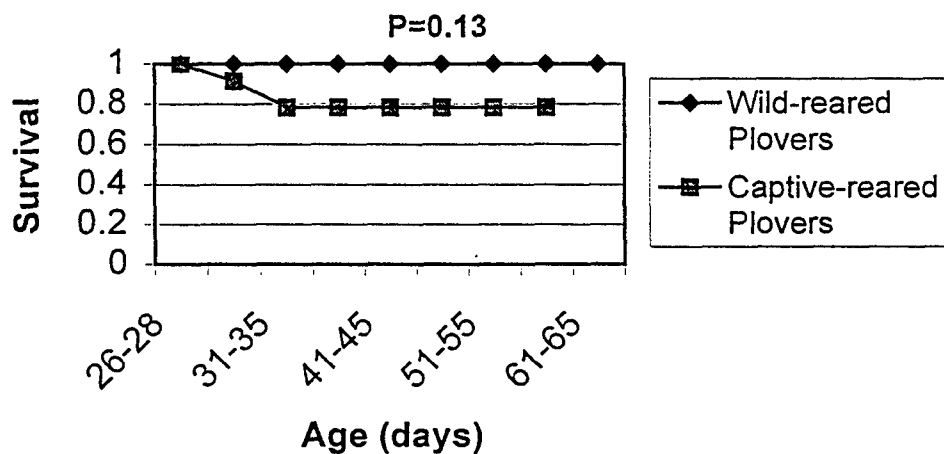


Figure 4. Post-fledging survival of captive- and wild-reared piping plovers.

One flagged bird has been seen on the wintering grounds to date. The “recaptured” bird was a wild-reared plover that was radioed on July 30th, was last seen in the area on August 10th, and was spotted in Florida on September 13th.

Behavior

Our behavior information has not been analyzed at this point. We would like to make some changes in our behavioral sampling for next year. We will focus on gathering captive-reared piping plover data after birds have been released back to the wild. We will still observe wild-reared plovers from hatching to migration but we will divide our days into 2-hour intervals and randomize our sampling efforts.

MANAGEMENT IMPLICATIONS

Predictive models for the Great Plains population of piping plovers are lacking juvenile and fledgling survival data. Our study will provide some of this needed information to improve current models and allow managers to better determine where to focus their efforts.

DISTRIBUTION, PRODUCTIVITY, AND HABITAT USE BY
INTERIOR LEAST TERNS AND PIPING PLOVERS ON THE NIOBRARA RIVER
IN NORTHERN NEBRASKA, 1996-1997

BY
STACY L. ADOLF

A thesis submitted in partial fulfillment
of the requirements for the degree
Master of Science
South Dakota State University
1998

DISTRIBUTION, PRODUCTIVITY, AND HABITAT USE BY INTERIOR LEAST
TERNS AND PIPING PLOVERS ON THE NIOBRARA RIVER IN NORTHERN
NEBRASKA, 1996-1997

This thesis is approved as a creditable and independent investigation by a candidate for the Master of Science degree and is acceptable for meeting the thesis requirements for this degree. Acceptance of this thesis does not imply that the conclusions reached by the candidate are necessarily the conclusions of the major department.

Dr. Kenneth F. Higgins Date
Thesis Advisor

Dr. Charles G. Scalet Date
Head, Dept. Of Wildlife
and Fisheries Sciences

Acknowledgments

I would like to thank Dr. Kenneth F. Higgins, my thesis advisor, for his support and advice throughout this field project and thesis. I would like to thank my co-principal investigators, Casey D. Kruse and Dr. Rex R. Johnson. I especially thank Rex for being my co-advisor on the field project and thesis. I thank Casey for believing in me and making my co-op possible. Without the help and guidance of these three people, I would have not been able to complete this thesis. I also thank my committee members, Dr. Lester Flake, Dr. Paul Evenson, and Dr. Allen Branum, without whom the end would not have become a reality. I give my thanks to Dr. Paul Evenson and Dr. Rex Johnson for all of their statistical advice and assistance. I extend thanks to the John Dinan of the Nebraska Game and Parks Commission for his help and ideas and to Dan Roberts for the loan of a leaky airboat. I especially want to thank my technicians, Jeremy Duckwitz, Mathew Bedard, and Jeremy Higgins who endured fickle weather and long hot days without ever tipping the canoe. I also send special appreciation to the Skyline Motel, Pam and Denny Wendell, the Pfeiffer family, and the town of Spencer for their friendliness, and for making me feel at home. I also acknowledge all the landowners who graciously allowed access to the Niobrara River.

I also would like to thank my family for their never ending love and support. A deep gratitude and special thanks are extended to my mother, Sharry. She has always believed in me and been there when I needed someone to listen. I especially thank her and Michael Upgren for their support which made the completion of my thesis possible.

This project was funded by the Army Corps of Engineers (COE), Operations

Division, Omaha District, Yankton, SD via Cooperative Agreement Research Work Order (R.W.O. No. 56) through the South Dakota Cooperative Fish and Wildlife Research Unit with South Dakota State University, South Dakota Game, Fish and Parks, U.S. Geological Survey, U.S. Fish and Wildlife Service, and the Wildlife Management Institute cooperating.

Abstract

DISTRIBUTION, PRODUCTIVITY, AND HABITAT USE BY INTERIOR LEAST
TERNS AND PIPING PLOVERS ON THE NIOBRARA RIVER IN NORTHERN
NEBRASKA, 1996-1997

Stacy L. Adolf

1998

Interior least terns (*Sterna antillarum athalassos*) and piping plovers (*Charadrius melodus*) are endangered and threatened species, respectively, and have been protected under the Endangered Species Act since 1985. Dam building on the Missouri River has produced changes in the availability and suitability of nesting habitats while both species continue to experience population declines throughout their range. The Niobrara River in Nebraska is one of the least modified rivers in the northern Great Plains that currently supports breeding populations of least terns and piping plovers. Evaluating the Niobrara River with its relatively undisturbed hydrologic regime provided information about least tern and piping plover habitat selection, productivity and distribution along a relatively natural river. Both species were first recorded nesting on the Niobrara River since before 1902 while in more recent years, this river has been identified as a significant production area. The Niobrara River was surveyed comprehensively during the summers of 1996 and 1997 for least terns and piping plovers. Nesting sites were identified and various nest site parameters were measured. Distribution of the nesting birds, productivity, nest success and habitat use were also evaluated. Aerial videography was flown for the Niobrara River

in early June of 1996 and 1997. Sandbar characteristics including total area and areas of high, low, wet sand, and heavy vegetation were obtained from the videography. Least terns and piping plovers were found along the entire portion of the Niobrara River monitored in 1996 and 1997 and equaled 30% to 40% of the total Nebraska population. Piping plovers usually initiated nests earlier than least terns with terns being more synchronous nesters than plovers. Piping plover known fate nest success ranged from 54% in 1996 to 73% in 1997 while least tern nest success was 80% during the 1996 and 1997 breeding seasons. In 1996 and 1997 respectively, the majority of sandbars used for nesting by least terns also supported nesting piping plovers. Other analyses, including the aerial videography analysis, also suggested that terns and piping plovers were selecting for the same types of habitat. Least terns may also be keying in on the presence of piping plovers and decreased amounts of vegetative cover in their selection of islands for nesting. Piping plovers, however, are selecting for high sand and the presence of heavy vegetative clumps on the sandbars. Using analysis of aerial videography, least terns were determined to need 1.3% of an island's total area in high sand and > 7% of low sand. Piping plovers also needed at least 1.3% of an island to be in high sand and > 9% of the total island area in low sand. Therefore, it is possible that one nesting habitat model based on piping plover selected characteristics could be developed and used to predict the use or non-use of a sandbar for nesting by both species.

Table of Contents

ACKNOWLEDGMENTS	iii
ABSTRACT	v
LIST OF TABLES	ix
LIST OF FIGURES	x
CHAPTER 1. INTRODUCTION AND DESCRIPTION OF STUDY AREA	1
GENERAL INTRODUCTION	1
LITERATURE REVIEW	3
STUDY AREA	7
CHAPTER 2. DISTRIBUTION AND PRODUCTIVITY OF LEAST TERNS AND PIPING PLOVERS ON THE NIOBRARA RIVER	14
INTRODUCTION	14
METHODS	14
RESULTS	20
DISCUSSION	25
CHAPTER 3. HABITAT USE AND CRITERIA FOR LEAST TERN AND PIPING PLOVER SELECTION OF NESTING SITES	30
INTRODUCTION	30
METHODS	31
Statistical Analyses	35
RESULTS	36

Nest Sites	36
Colony Sites	38
DISCUSSION	48
CHAPTER 4. CONCLUSIONS AND RECOMMENDATIONS	53
LITERATURE CITED	57
APPENDICES	62
Appendix A. Niobrara River study sites for reaches 1 - 11, 1996 -1997	62
Appendix B. Standardized data sheets.	75

LIST OF TABLES

1. International piping plover and least tern census numbers for 1996 (River Miles 0.0 to 120.0) and partial census numbers for 1997 (River Miles 14.7 to 39.0 and 51.5 to 79.9) on the Niobrara River 21
2. Colony sites used and numbers of nests initiated per site in 1996 and 1997 by nesting piping plovers and least terns on the Niobrara River 22
3. Piping plover and least tern nest initiation dates, 1 May - 30 July 1996 and 1997, (including Julian dates) on the Niobrara River, NE 24
4. Piping plovers and least terns average clutch size, nest, hatching, and fledgling success and fledge ratio on the Niobrara River in 1996 and 1997 26
5. Least tern and piping plover nest fates along the Niobrara River in Nebraska during 1996 and 1997. 27
6. Mean percent of substrate types and moisture content (SE) by visual estimation for 1996 and 1997 piping plover and least tern nests on the Niobrara River, NE. . . 37
7. Mean percent vegetative cover (SE) and mean vegetation height (SE) (cm) by visual estimation for 1996 and 1997 piping plover and least tern nests on the Niobrara River, NE. 39
8. 1996 and 1997 nest elevations (cm) and distances (m) from the water for least terns and piping plovers on the Niobrara River 39
9. Mean percent substrate types (SE) and moisture content (SE) from visual estimates for 1996 and 1997 piping plover and least tern colony sites as well as for 1997 comparison islands on the Niobrara River, NE 41
10. Mean percent vegetative cover (SE), mean vegetation height (SE), and percent of heavy vegetation (SE) from visual estimation for 1996 and 1997 piping plover and least tern nesting sites as well as for 1997 comparison islands on the Niobrara River, NE. 41
11. Mean and median values (ha) and percentages of composition for island colony site characteristics measured from aerial videography for 1996-1997 on the Niobrara River, NE. 44
12. Characteristics (ha) of islands used by piping plovers and least terns for nesting from 1997 aerial videography on the Niobrara River, NE 47

LIST OF FIGURES

1. Niobrara River study area (1996-1997) within the Upper Missouri River Drainage Basin 8
2. Hydrography of the Niobrara River for 1996, 1997, and a high water year average for years 1944, 1950-54, 1957, 1960, 1962-63, 1973, 1977-78, 1982-84, 1986-88, and 1991-95 9
3. Study area on the Niobrara River from the Confluence with the Missouri River (R.M. 0.0) to the Norden Bridge (R.M. 120.0). 12
4. Egg floatation method for determining incubation stage of least tern and piping plover eggs (adapted from Hays and LeCroy 1971, modified by Schwalbach 1988). Egg position shows the number of days into incubation indicated for least tern and piping plovers (in parentheses) 17

CHAPTER 1. INTRODUCTION AND DESCRIPTION OF STUDY AREA

GENERAL INTRODUCTION

Interior least terns (*Sterna antillarum athalassos*) and piping plovers of the Great Plains (*Charadrius melodus*) are federally listed endangered and threatened species, respectively, with both species being protected under the Endangered Species Act since 1985. They are also sympatric nesters, breeding and nesting together throughout the northern Great Plains (Ziewitz et al. 1992). Concentrations of both species can be found along the Mississippi, Missouri, Platte, Yellowstone, and Niobrara rivers (Ducey 1981, 1985, Ziewitz et al. 1992).

Least terns and piping plovers depend on sandbars that are bare or only sparsely vegetated for nesting and brood-rearing (Carreker 1985, Ducey 1985, 1989a). Terns and plovers utilize large sandbars (Kirsch 1996) that are low in elevation and often near mid-channel (Dinan et al. 1985, USACE 1987). Availability of these essential nesting habitats is declining along most rivers in the northern Great Plains. This is largely the result of dam construction (Ducey 1981), channelization projects, altered flow regimes, and changes in surrounding land use on most of the large rivers including the Missouri River (Faanes 1983, Sidle et al. 1991, Smith and Renken 1991, USFWS 1985). Dammed and channelized rivers exhibit regulated flows and the cycle of natural spring flooding is either largely controlled or totally eliminated. River channels were deepened and shortened (Whitman 1988), channel size was reduced, and vital mid-river sandbars were destroyed to straighten and control the rivers (Ducey 1981, Ziewitz et al. 1992). Typical sandbars are not created in these situations because the sediment loads are dropped as they reach the

reservoirs, never continuing downstream to build new sandbars (USFWS 1985). The new, straighter river channels also allow sediments carried by the river to be swept through the channel instead of being deposited as sandbars (Dryer and Dryer 1985, Wingfield 1978, Ziewitz et al. 1992). Without this type of flooding, vegetation encroaching on the few sandbars that are left is not scoured away (Faanes 1983, Kirsch 1987, Sidle et al. 1992), making these remaining sandbar and island habitats unsuitable for nesting. When shoreline or any type of riverine habitat becomes wooded and vegetated, they cease to be dynamic. This new stability creates a narrower channel, constricts the flow, and increases flow velocity (Lingle 1988).

The Niobrara River in Nebraska and Colorado is one of the least modified rivers in the northern Great Plains that currently supports breeding populations of least terns and piping plovers. It is only marginally modified by control structures and exhibits a relatively natural flow pattern. Flows in the Niobrara are typically dominated by a brief period of plains snowmelt and then sustained by summer precipitation and steady ground water discharge (National Park Service 1995).

A paucity of data exists on least tern and piping plover reactions to natural river systems (Kreil and Dryer 1987), an exception being a study on the Yellowstone River in Montana concerning the nesting ecology of least terns (Bacon 1996). However, extensive records of least tern and piping plover nesting habitat availability on the mainstem Missouri River are almost nonexistent before dam construction (USFWS 1990). Consequently, determining the extent of change in habitat availability and suitability is difficult. By evaluating the Niobrara River's natural hydrologic regime, some insights on

least tern and piping plover habitat use and productivity may be gained to help develop and improve water management strategies that would enhance the production of plovers and terns on the Missouri River. This underlying goal of increased plover and tern production along the Missouri River is a primary justification for the study of a natural river system such as the Niobrara River.

Objectives of my study were 1) to determine piping plover and least tern habitats and their suitability for nesting and brood-rearing along the Niobrara River in northern Nebraska during the spring and summer of 1996 and 1997; 2) to determine the population, distribution, and reproductive success of piping plovers and least terns along the Niobrara River; and 3) to identify habitat criteria based on parameters for productive habitats on the Niobrara River to aid in habitat construction and management on the mainstem Missouri River and to give a better understanding of the birds nesting site requirements.

LITERATURE REVIEW

Throughout their range, least terns and piping plovers are experiencing population declines. Although the northern Great Plains supports 10 to 11% of the estimated population worldwide, full scale surveys of these two species in the interior Great Plains were not conducted until the 1991 and 1996 International Piping Plover Censuses (USACE 1987). Least terns were also monitored during these censuses.

Least terns and piping plovers nest on sandbars and islands along the mainstem Missouri River as well as on many of its tributaries (Higgins and Brashier 1993). Both species nest on relatively open areas of sand and gravel beaches, sandbars, and islands. Nests are shallow scrapes in the sand that can be lined or unlined (Cairns 1982). They

also commonly nest near an object such as a piece of driftwood or a small plant (Dirks 1990, Ducey 1989a, Haig 1992).

The percent cover of sandbar vegetation tolerated by least terns and piping plovers varies from 0 to 20% (Carreker 1985, Haig 1992). In Nebraska, sandbar vegetation was usually less than 10% (Carreker 1985). Sparse vegetation may provide chicks with shade and escape cover from predators. In a natural river system such as the Niobrara River, sandbars are usually scoured by ice during high spring flows (Sidle et al. 1991). The majority of the vegetation on the sandbars is removed during this scouring. Habitat characteristics are inherently variable due to the nature of river systems. However, the pioneering behavior of plovers and terns emphasizes the ability to respond to the dynamic characteristics of sandbar habitats. This is especially evident as they are forced to abandon vegetated older bars in favor of newly deposited sandbars that are more barren.

Substrate type is important in determining least tern and piping plover nesting habitat. Sand, gravel, and shell-based substrates are usually selected for over silty substrates (Schwalbach 1988). Sand substrate used for nesting is usually relatively fine with lesser amounts of coarse sand, pebbles, and shell fragments incorporated (Kotliar and Burger 1986). Nesting substrate moisture can vary from very damp to very dry.

A crucial requirement of nesting habitats suitable for use by piping plovers and least terns is that the habitats are in close proximity to adequate foraging areas. Foraging habitats for least terns consist of shallow, open water with an abundance of small minnows. However, it is probable that they will fly for great distances depending on forage availability (Faanes 1983). It is also assumed that non-breeding adults will travel

farther to find food than brooding adults (Carreker 1985). Piping plovers forage along shorelines and mudflats for invertebrates in both their neutral feeding grounds (mudflats) and within the defined breeding territory (USFWS 1988). These food sources can only be a short distance from the brooding sites since newly hatched piping plover chicks must forage for themselves.

Least terns and piping plovers are philopatric species and adults have a strong tendency to return to their past breeding areas (Burger 1984, Cairns 1982). Haig and Oring (1988) found that 68% of the returning adult plovers nested at sites used the previous year. Least terns are colonial nesters and they exhibit definite group adherence. Colonial nesters habitually nest in groups with their nests situated close together. This increases their predator awareness and their ability to collectively mob potential predators and drive them from the colony. Occasionally, group adherence has been found to override the importance of habitat suitability for a short time (Carreker 1985). Even when productivity declines in one colony site, the birds may continue to return to the site (Burger 1984).

The majority of rivers in the Northern Great Plains region do not support suitable or productive nesting habitat for least terns and piping plovers. Most of these rivers have been greatly modified by construction of dams, which in turn, created reservoirs and altered river flows. Upon entering a reservoir, river flow slows and the sediment load is mostly dropped. The water now leaving the reservoir comes from the lake bottom and is clear and cold, very unlike the warm sediment laden water which entered the system. Little sediment is left to travel downstream and create sandbars (USFWS 1985).

Least terns and piping plovers are vulnerable to natural and human induced habitat destruction and disturbance that could possibly be moderated by management. High water levels may prevent least terns and piping plovers from nesting by inundating nesting habitat, destroying nests, and drowning chicks. However, high water levels may keep them from nesting in flood prone areas for years with above average high releases (Dinan et al. 1985). Nest inundation on natural rivers occurs when flows increase due to heavy rainfall in the watershed contributing to nest loss as well as chick mortality (Dryer and Dryer 1985, USACE 1987).

Grazing shoreline habitats may reduce tern and plover nesting habitat suitability and productivity. Cattle often degrade sandbars during their access to river and lake-side watering areas (Schwalbach 1988). Sandbars become trampled and manure covered. Deep hoofprints can trap young chicks that fall into them. Fertilizer and manure from surrounding farms enrich the sand and encourage growth of vegetation. This vegetation will eventually eliminate potential nest sites.

Predation reduces least tern and piping plover productivity. Eggs, chicks, and adults are all susceptible. Primary predators include mink (*Mustela vison*), raccoon (*Procyon lotor*), gulls (*Larus spp.*), crows (*Corvus spp.*), great horned owls (*Bubo virginianus*), great blue herons (*Ardea herodias*), dogs, and cats (Kruse 1993). Several management techniques have been developed to reduce predation. These include predator exclosures constructed around colonies (Mayer and Ryan 1991, Minsky 1980) and individual nests (Deblinger et al. 1992, Melvin et al. 1992, Rimmer and Deblinger 1990), trapping and removal of predators, and use of strobe-light systems (Kruse 1993).

Human disturbance of nesting colonies can also reduce least tern and piping plover productivity. Off-road vehicles crush nests and chicks on sandbars and beaches (Ducey 1981). People walking or camping on colonies disturb nesting adults leading to nest abandonment or addling of eggs (Dryer and Dryer 1985). Symbolic fencing, using signs and twine, and public education are being used to discourage human activity at large colony sites (Dirks 1990).

STUDY AREA

The Niobrara River is one of the most undeveloped rivers within the northern Great Plains extending approximately 719.2 kilometers (km) (447 miles) from west to east (Fig. 1). It originates in southeastern Wyoming and runs just south of the Nebraska/South Dakota border until it meets the Missouri River. The word "Niobrara" means "running water" in the Sioux language referring to the rivers' constant year-round flow. It is also considered one of the fastest flowing rivers in the world not associated with a mountainous region (Norfolk News 1964). My study area included the eastern section of the river where the valley widens enough for the channel to become braided with clustered sandbars. High spring discharges for the Niobrara River are usually between 28.31 and 42.47 cubic meters per second (cms) [1,000 and 1,500 cubic feet per second (cfs)] while low flows are usually between 9.91 and 13.02 cms (350 to 460 cfs) (Buchanan 1981) (Fig. 2). Flow extremes have ranged from a high flow of 76.44 cms (2700 cfs) and greater down to a low flow of 6.23 cms (220 cfs) or less in years of severe drought. During high flows, such as in the spring, the river exhibits a recognizable, meandering channel or thalweg. When flows diminish later in the summer and during the fall, the thalweg

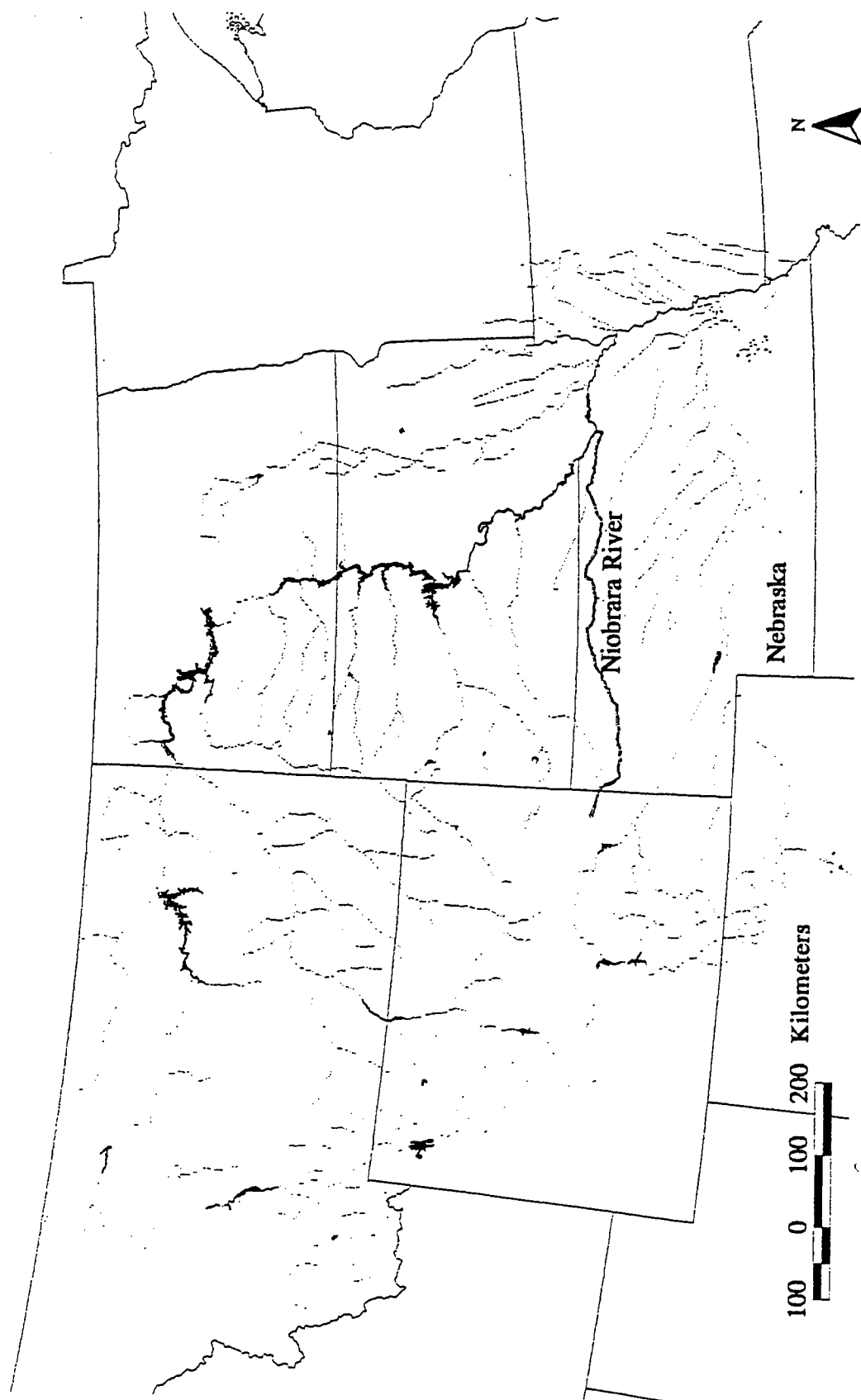


Figure 1. Niobrara River Study Area (1996-1997) within the Upper Missouri River Drainage Basin.

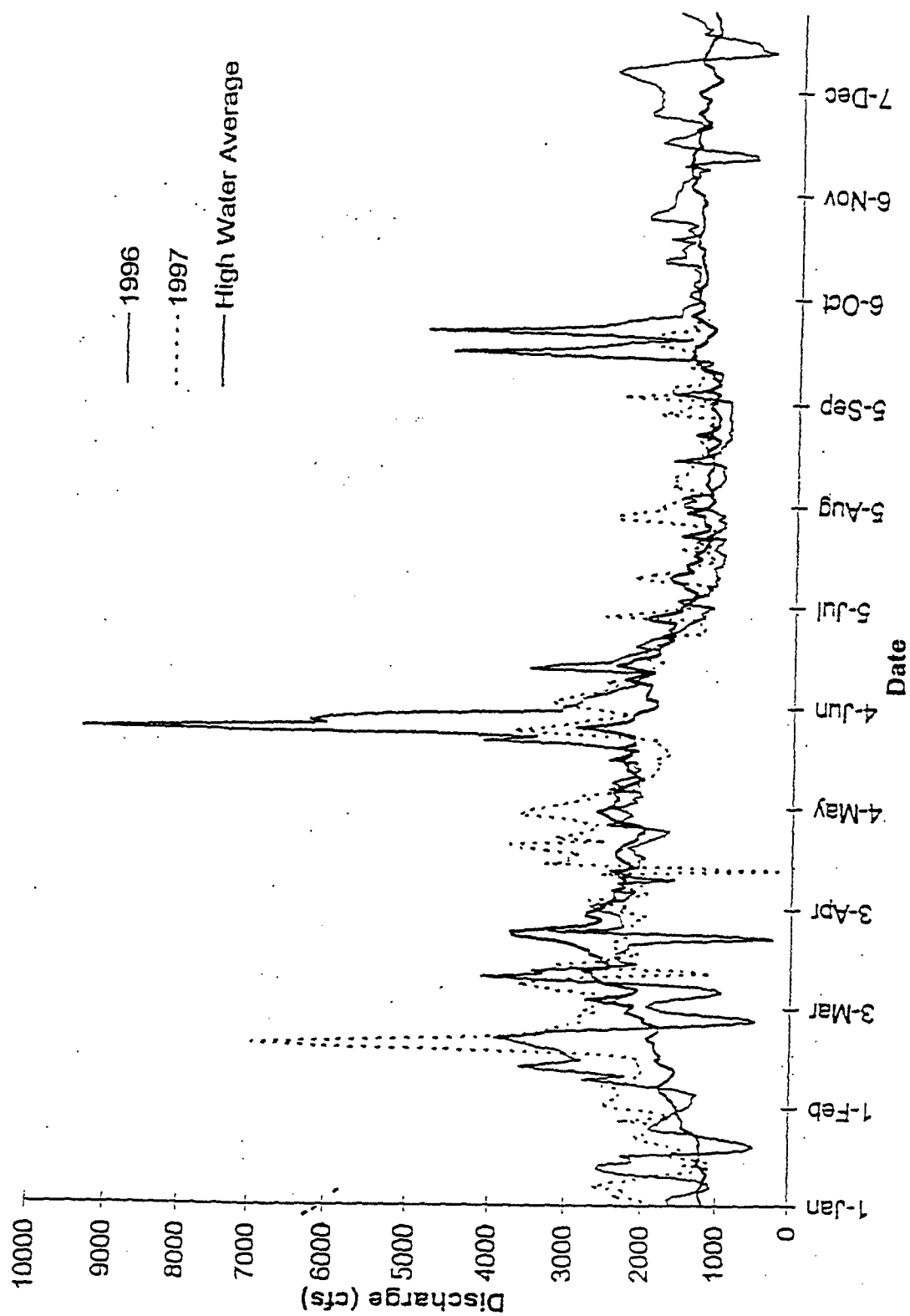


Figure 2. Hydrography of the Niobrara River for 1996, 1997, and a High Water Year Average for years 1944, 1950-54, 1957, 1960, 1962-63, 1973, 1977-78, 1982-84, 1986-88, and 1991-95.

disappears and the Niobrara River has characteristics of a braided river system with large, flat linguoid sandbars. Water depths vary with the seasons and range from a few centimeters (inches) in summer and fall to 1.52 meters (m) (5 feet) or greater in spring (Buchanan 1981).

The early spring runoff of the Niobrara River starting in January, February, March, and April is attributed to snowmelt from the plains. During the rest of the year, the base flow of the Niobrara River is dependent on groundwater discharge, tributary inflow, and isolated heavy rain events. Groundwater discharge inputs help to produce a year-round base flow with few flood events (Bleed and Flowerday 1997).

The Niobrara River has many large and small tributaries associated with it. A few of the largest are the Keya Paha and Snake rivers, and Minnechaduza, Plum and Long Pine creeks. All except the Keya Paha are groundwater-based streams, which are regulated by surface runoff. This large number of groundwater-based creeks and rivers flowing into the Niobrara River help to keep it flowing year-round. However, before its confluence with the Missouri River, the flows of the Niobrara River are split between the main channel and the Mormon Canal.

Impoundments on the Niobrara River include the Box Butte Reservoir which was part of the Mirage Flats Irrigation project established in 1946. The Merritt Reservoir, on the Snake River, is associated with the Ainsworth Irrigation Project which started in 1964. The Snake River is a major tributary of the Niobrara River but its dam reduced the mean monthly discharge of the Niobrara River over 15%. The lower two impoundments on the Niobrara River are the Niobrara Hydroelectric Plant which is now inoperable, and

the Spencer Hydroelectric Plant. The Niobrara Hydroelectric Plant is now a run-of-the-river plant which no longer affects the flows on the Niobrara (Buchanan 1981). The Spencer Hydroelectric Plant and its associated dam began operation in 1927 and although siltation has reduced the storage capacity of the reservoir, the plant is still in operation. The Spencer dam supplies supplemental power to the surrounding communities but it has caused a dramatic impact on the channel downstream since its initiation, causing channel narrowing and sandbar degradation. Other structures on the Niobrara River include several areas where pilings and rip-rap are being used to control the channel. These control structures were implemented to prevent the channel flows from affecting the dam and to keep the channel directed under various bridges (Norfolk News 1964). The construction of these dams and control structures has resulted in decreased peak flows and a change in the annual mean flow of the Niobrara River (Buchanan 1981).

The primary land use along the Niobrara River is farming and ranching. Cattle ranching is more predominate on the western half of the Niobrara River while farming is more prevalent further east along the river. The floodplain of the Niobrara River is often utilized for hay meadows while river water has been used extensively for irrigation purposes since 1938 (Buchanan 1981).

Access to the river is limited. Few roads parallel the river, and those that do are often access roads to private ranches. Bridges across the Niobrara River are between 8.1 and 17.7 km (5 and 11 miles) apart. Since bridges are the only points of regular access to the Niobrara River, my study area (Fig. 3) was separated into 11 reaches corresponding to the areas between bridges (Appendix A). Reach 1 extended from the confluence with the

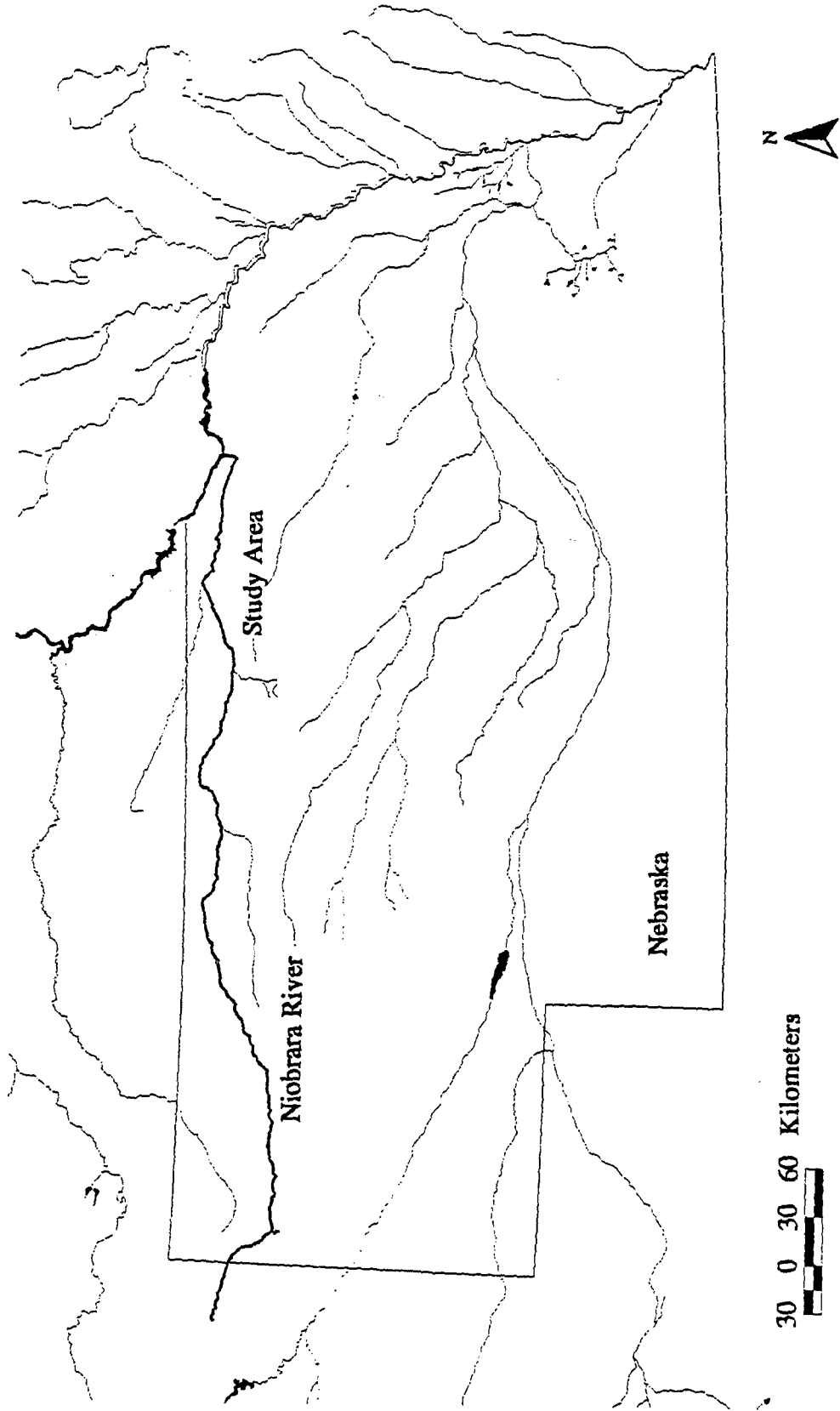


Figure 3. Study Area on the Niobrara River from the Confluence with the Missouri River (R.M. 0.0) to the Norden Bridge (R.M. 120.0).

Missouri River and the walking bridge over the Niobrara River upstream to Pischelville Bridge south of Verdel, NE; reach 2 extended from Pischelville Bridge to Redbird Bridge, south of Lynch, NE; reach 3 extended from the Redbird Bridge to the Highway 281 Bridge southeast of Spencer, NE; reach 4 extended from the Spencer Dam west to the Highway 11 Parshall Bridge south of Butte, NE; reach 5 extended from the Highway 11 bridge to the Grand Rapids Bridge south Naper, NE; reach 6 extended from the section west of the Grand Rapids Bridge to the Highway 137 Mariaville Bridge; reach 7 extended west from the Highway 137 Bridge to the Carns Bridge; reach 8 extended from the Carns Bridge to the Highway 7 Riverview Bridge; reach 9 extended from the Highway 7 Bridge to the Highway 183 Bassett Bridge south of Springview; reach 10 extended from the Highway 183 Bridge west to the Meadville Bridge; and reach 11 extended from the Meadville Bridge west to the Norden Bridge. Where the river could not be accessed by public bridges, cooperation from private landowners allowed access.

The 1996 study area included reaches 1 through 8 with reach 7 being monitored only for the first month of the field season due to lack of nesting piping plovers or least terns. These reaches totaled approximately 193.1 km (120 river miles (R.M.)). The 1996 International Piping Plover Census extended further west than the 1996 study area, adding reaches 9 through 11 to the census area. In 1997, the study area was reduced to reaches 2, 3, 5, and 6 or about 80.5- 96.5 km (50-60 miles) to facilitate more intensive monitoring of selected habitat areas. The reaches with a history of high populations of nesting birds of both species were chosen for the 1997 field season study area.

CHAPTER 2. DISTRIBUTION AND PRODUCTIVITY OF LEAST TERNS AND PIPING PLOVERS ON THE NIOBRARA RIVER

INTRODUCTION

Least terns and piping plovers have been recorded nesting on the Niobrara River from its confluence with the Missouri River upstream to Norden, NE since the first recorded nesting of least terns and piping plovers in the area in 1902 (Ducey 1989b). More recently the Nebraska Game and Parks Commission (NGPC) has been conducting surveys on the Niobrara River from 1978 through 1988 and then again in 1991 and 1996 (Wingfield 1984, 1988). Least terns have been monitored since 1975 (Wingfield 1978) with monitoring of piping plovers on the Niobrara River beginning in 1984 (Wingfield 1984). According to the surveys of the NGPC, the number of interior least terns and piping plovers appears to be increasing on the Niobrara River. In 1981, 97 adult least terns and 92 adult piping plovers were found during the census. However, in 1991, just 10 years later, 291 least terns and 162 piping plovers were found on the same route during the first International Piping Plover Census. In 1991, the Niobrara River supported roughly 41% of Nebraska's piping plover population and 35% of its least tern population. During the annual International Piping Plover Census in 1996, about 30% of Nebraska's piping plovers and 32% of its' least terns were found on the Niobrara River (Dinan 1996). This demonstrates the importance of the Niobrara River as an essential breeding habitat for least terns and piping plovers.

METHODS

All adults of both species were counted each year on the study area along with an

approximate nest count for the entire study area and whether the adults were nesting, unmated, or associated with an island. This period coincided with the counts on the mainstem Missouri River system to prevent possible double counting of birds due to movements from river to river or from island to island after nest failure. All counts were recorded on standardized census data cards used by the United States Army Corps of Engineers, Omaha District (Appendix B). During the 1996 field season, the International Piping Plover Census was conducted on the Niobrara River from 17-20 June for reaches 1 through 11. Reaches 10 and 11 were canoed, while reaches 1 through 9 were surveyed from an airboat.

Distribution of nesting birds was determined with surveys of each river reach on a 7-10 day cycle in 1996 and 1997. These original surveys were conducted to determine initial sandbar nesting site selection by terns and plovers. All islands, sandbars, and shorelines were surveyed and monitored from a canoe and/or by wading. Potential nesting sites were determined by observing territorial adults with a spotting scope or binoculars and by walking the island. Nesting sites and other potentially suitable sandbars were searched on foot for nests or territorial adults. Once breeding birds were known to have begun nesting, productivity monitoring started and consisted of surveying each sandbar every 7-21 days with up to 8 visits per sandbar. Sandbars used for nesting by either least terns or piping plovers or both were then assigned a 3-digit site number. The first digit corresponded to the river reach in which the sandbar was located, while the second and third digits represented the colony's number within that river reach. In 1996, surveys began on 17 May and continued through 13 August while in 1997, surveys began on 12

May and continued through 14 August.

The number of nests initiated, nest initiation dates, number of eggs laid, number of eggs hatched, nest fate (successful/unsuccessful), and reason for nest termination were determined for each colony nesting site. Once an individual nest was identified, it was marked with a numbered wooden tongue depressor (Smith 1987), placed approximately 1 m north of each nest bowl (Dirks 1990). The number of eggs per nest and their present incubation stage were recorded during each visit. Incubation stage was determined for the clutch if the clutch was not found in the laying stage. If a full clutch was found, the incubation was estimated to the nearest day \pm 3 days using the egg floatation technique developed by Hays and LeCroy (1971) as modified by Schwalbach (1988) (Fig. 4).

Nest initiation dates were back calculated upon finding a nest in the laying stage. If a completed clutch was found, incubation was determined using the egg floatation technique. Nest initiation was then calculated by adding the number of days incubated plus the number of eggs in a clutch multiplied by 1 if it is a least tern nest but multiplied by 2 and then subtract 1 if it is a piping plover nest. This number was then subtracted from the visit date to produce the nest initiation date. Least terns usually lay 1 egg a day for 3 days resulting in a normal clutch of 3 eggs. Incubation begins once the last egg is laid and typically lasts for 18-21 days (USFWS 1990). Piping plovers lay 1 egg every other day until a standard 4 egg clutch is completed. For re-nesting attempts, 3 eggs per clutch are typical. Incubation begins once the final egg is laid and typically lasts for 25 to 31 days (Haig and Oring 1987). Hatching dates were approximated by adding 20 days to the estimated least tern nest initiation date and by adding 32 days to the

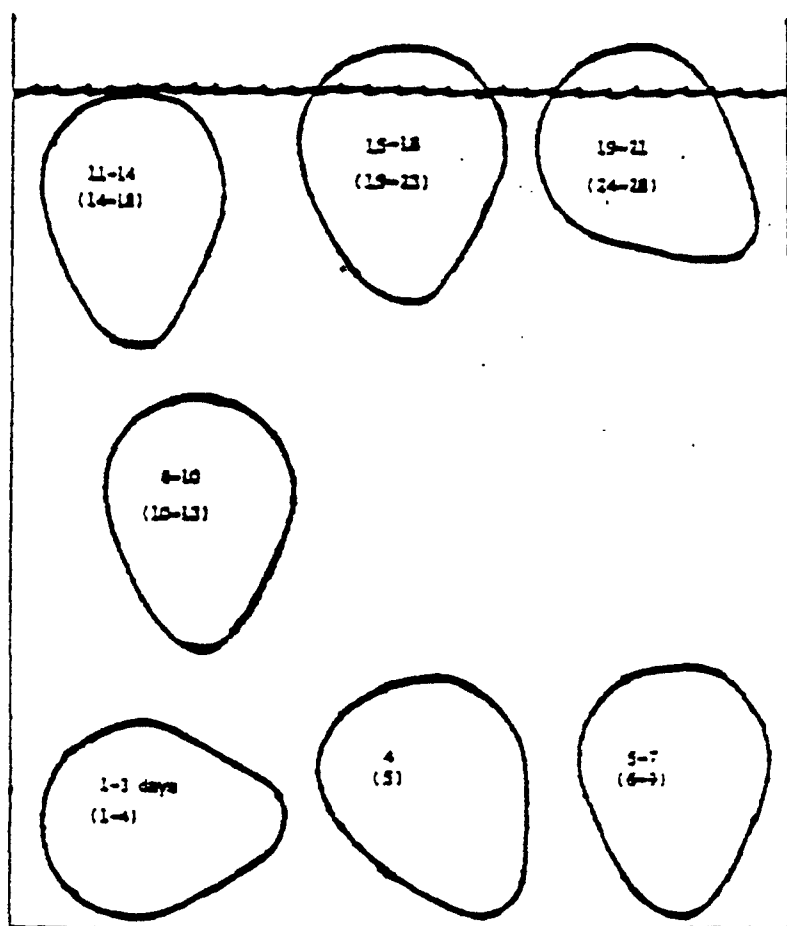


Figure 4. Egg floatation method for determining incubation stage of least tern and piping plover eggs (adapted from Hays and LeCroy 1971, modified by Schwalbach 1988). Egg position are show with the number of days into incubation indicated for least tern and piping plovers (in parentheses).

estimated piping plover nest initiation date. If a piping plover or least tern nest was found in the laying stage, the nest initiation date was not calculated by the floatation method. The nest initiation date could be determined solely by back calculating. This means that the number of eggs in the nest was multiplied by either 1 for least terns or 2 for piping plovers. For piping plovers, a 1 is then subtracted from this resulting number. The resulting number for either terns or plovers was subtracted from the visit date to estimate the initiation date.

The nest status was also documented as either unknown, normal, abandoned, eggs missing, hatched, destroyed, or other. Nest fate was determined as either hatched, destroyed, abandoned, eggs nonviable, or nest fate unknown. Possible reasons for nest termination were also recorded. The number of eggs for either species that hatched, were added or were destroyed was documented.

Average clutch size for least terns and piping plovers was calculated by dividing the total number of eggs per year for each species by the total number of nests initiated. For example, in 1996 piping plovers initiated 126 nests with 447 eggs being laid. This results in an average clutch size of 3.6 eggs per nest. Nest success was calculated by dividing the number of nests hatched by the total number of nests initiated per species. Hatching success of eggs was produced by dividing the number of eggs hatched by the total number of eggs laid by each species. Fledging success was calculated by dividing the number of number of chicks fledged for each species by the number of hatched eggs per species. Fledge ratio was calculated as number of chicks fledged per pair of adults for each species. Nest success, hatching success, and fledging success were converted to

percentages by multiplying the number by 100. Nesting and fledging success were determined for the entire length of the study area.

The numbers of chicks fledged, date fledged, and possible reasons for any chick mortality were documented. Piping plover chicks 20+ days old and least tern chicks 15+ days old were considered fledged. Chick age was determined by size, general appearance, and degree of emergence of primary wing feathers. Chicks were not captured to determine the degree of primary emergence; this was determined visually through binoculars or upon finding a chick on the sandbar.

Monitoring of the nesting islands continued until all chicks were estimated to be fledged or until the site was no longer occupied. All nest information was recorded on standardized nest record data cards supplied by the U.S. Army Corps of Engineers, Omaha District (Appendix B). Adult census data and chick data such as age and number of chicks were recorded on standardized census data cards supplied by the U.S. Army Corps of Engineers, Omaha District (Appendix B).

Various types of disturbance such as human, vehicle, or predator were recorded when evident at or around nesting sites. Predator evidence included the presence of tracks, scat, owl pellets, talon strike marks, and remains of chicks and adults. Destruction or disturbance of nests due to high or low river flows as well as damage from wind, rain, hail, etc., were also recorded when evident for each sandbar. Disturbance by biologists was kept to a minimum during all colony visits. Sandbars were not visited in extremely hot weather ($> 32^{\circ}\text{C}$ or 90°F), during rain, excessive wind (> 32 kph or 20 mph), and other adverse weather conditions to reduce the exposure of eggs and young to heat and

cold extremes (Haig and Plissner 1993, Dirks 1990). Length of visits was kept to 30 minutes or less per colony. If the colony was exceptionally large, no more than 30 minutes was spent on each portion of the sandbar. The welfare of nests, chicks, and adults was deemed more important than following schedules or survey procedures. All monitoring, censusing, and nest surveys were conducted under permits in accordance with the guidelines for monitoring least terns and piping plovers.

RESULTS

Based on my census of the study area, piping plovers totaled 107 in 1996 and 87 in 1997 and least terns totaled 321 in 1996 and 183 in 1997 (Table 1). Abundance of piping plovers and least terns were lower in 1997 than in 1996 mainly due to the monitoring of fewer reaches or censusing only half the area monitored in 1996.

During 1996 and 1997, I found 543 nests (193 piping plovers; 350 least terns) on 53 colony sites (37 in 1996; 16 in 1997) (Table 2). Of these 53 colonies, 15 (28.3%) were used by only piping plovers, 2 (3.8%) by only terns, and 36 (67.9%) were used jointly by both species. The peak nest initiation period for piping plovers on the Niobrara River ranged from 1 - 26 June in 1996 and 1997, while the peak nest initiation period for least terns ranged from 3 - 25 June (Table 3).

A total of 1,603 eggs were found in the 543 nests initiated (703 piping plovers; 900 least terns) for 1996 and 1997 of which 731 (258 piping plovers; 473 least terns) occurred in successfully hatched nests for a hatching success of 45.6% (36.7% for piping plovers; 52.6% for least terns). Clutch size varied from 1.0 to 4.0 eggs/nest for piping plovers and from 1.0 to 3.0 eggs/nest for least terns. Average clutch size

Table 1. International piping plover and least tern census numbers for 1996 (River Miles 0.0 to 120.0) and partial census numbers for 1997 (River Miles 14.7 to 39.0 and 51.5 to 79.9) on the Niobrara River.

Year	Adults		Chicks Fledged	
	Piping Plover	Least Tern	Piping Plover	Least Tern
1996	107	321	37	96
1997	87	183	55	79
Totals	194	504	92	175

Table 2. Colony sites used and numbers of nests initiated per site in 1996 and 1997 by nesting piping plovers and least terns on the Niobrara River.

Site	River Mile	1996 Nests		1997 Nests	
		Plover	Tern	Plover	Tern
101A	1.0	7	3	.	.
106A	1.8	4	15	.	.
105A	2.1	10	18	.	.
104A	7.6	3	21	.	.
103A	10.4	1	1	.	.
102A	10.8	1	3	.	.
205A	15.8	5	6	.	.
205B	16.3	.	.	1	4
204A	17.0	3	5	.	.
203B	17.4	.	.	5	17
203A	NA	0	1	.	.
202A/204B	24.0	3	8	2	6
202B	27.9	.	.	1	1
201A	28.0	6	5	.	.
201B	28.8	.	.	9	13
303A	30.0	2	7	.	.
302B	30.5	.	.	4	13
304A	30.6	1	4	.	.
302A	N.A.	1	.	.	.
303B	36.0	.	.	0	9
301A/B	37.7	2	9	1	2
403A	39.7	6	15	.	.
406A	42.7	1	.	.	.
405A	44.2	3	5	.	.
404A	44.4	2	6	.	.
401A	46.5	6	7	.	.
402A	N.A.	.	1	.	.
505B	51.7	.	.	15	9
504B	52.8	.	.	1	0
508A	53.7	5	8	.	.
507A	55.0	5	4	.	.
503B	55.2	.	.	1	0
501B	56.2	.	.	1	0

Table 2 (Cont'd). Colony sites used and numbers of nests initiated per site in 1996 and 1997 by nesting piping plovers and least terns on the Niobrara River.

Site	River Mile	1996 Nests		1997 Nests	
		Plover	Tern	Plover	Tern
505A	58.3	5	11	.	.
503A	59.8	1	.	.	.
506A	59.0	1	.	.	.
502A	61.2	9	7	.	.
502B	61.7	.	.	13	33
501A	65.9	1	.	.	.
504A	N.A.	1	.	.	.
606A	66.9	9	13	.	.
603B	68.0	.	.	7	8
605A	71.2	3	1	.	.
604A	74.4	2	0	.	.
602B	75.3	.	.	5	18
603A	79.0	7	14	.	.
602A	79.5	1	.	.	.
601A/B	79.9	1	.	2	0
802A	90.0	6	19	.	.
801A	90.8	1	.	.	.
Total Nests ^a		125	217	68	133

^a yearly totals are not comparable because of study area reduction in 1997.

Table 3. Piping plover and least tern nest initiation dates, 1 May - 30 July 1996 and 1997, (including Julian dates) on the Niobrara River, NE.

Date	1996 Julian Date	1997 Julian Date	<u>Piping Plover</u>		<u>Least Tern</u>	
			1996	1997	1996	1997
May 1-7	122-128	121-127				
May 8-14	129-135	128-134	2	1		
May 15-21	136-142	135-141	0	4		
May 22-28	143-149	142-148	4	7		
May 29-Jun 4	150-156	149-155	20	18	3	17
Jun 5-11	157-163	156-162	25	13	75	26
Jun 12-18	164-170	163-169	37	16	58	12
Jun 19-25	171-177	170-176	16	5	45	5
Jun 26-Jul 2	178-184	177-183	15	4	5	2
Jul 3-9	185-191	184-190	4		11	1
Jul 10-16	192-198	191-197	3		12	2
Jul 17-23	199-205	198-204			4	1
Jul 24-30	206-212	205-211				
Total Nests ^a			68	27	133	66

^a yearly totals are not comparable because of study area reduction in 1997.

(eggs/nest) was 3.6 for piping plovers and 2.6 for least terns (Table 4).

Of the 543 nests initiated in 1996 and 1997, 249 hatched (67 piping plovers; 182 least terns) for an overall nest success of 45.9% (34.7% for piping plovers; 52.0% for least terns). Of the 543 nests initiated in 1996 and 1997, a total of 294 (126 piping plovers; 168 least terns) did not hatch. The leading causes of known nest failures were predation, flooding, and sandbar erosion (Table 5). During 1996 and 1997, 267 chicks (92 piping plover; 175 least tern) were fledged from 731 eggs for a fledgling success of 36.5% (35.7% for piping plovers; 37.0% for least terns) (Table 4).

DISCUSSION

Piping plover nest initiation normally occurs from late May to early June (Lingle 1988, Smith 1987). Schwalbach (1988) reported a median nest initiation dates of 20 June 1986 and 1 June 1987; the later date was a result of a high water year on the Missouri River. Nest initiations have been reported for interior piping plovers as early as 3 May to as late as 22 July (Faanes 1983, Lingle 1988). Least terns typically began nest initiations at the end of May (USFWS 1990) although median nest initiation dates of 23 June 1987 and 7 July 1986 were also found (Schwalbach 1988). Interior least tern nest initiation dates can range from 15 May to 24 June and even later into July. My median nest initiation findings on the Niobrara River generally correspond with other researchers for piping plovers and least terns; however, terns on the Niobrara River nested earlier than reported by Schwalbach (1988) for the Missouri River. For the Niobrara River, the least tern median nest initiation date was 14 June for 1996 and 9 June for 1997 whereas piping plovers had a median nest initiation date of 14 June in 1996 and 7 June in 1997.

Table 4. Piping plovers and least terns average clutch size, nest, hatching, and fledging success and fledge ratio on the Niobrara River in 1996 and 1997.

	Piping Plover		Least Tern	
	1996	1997	1996	1997
Average Clutch Size	3.58	3.75	2.51	2.68
Nest Success (%) ^a	32.0	39.7	53.5	49.6
Known Fate Nest Success (%) ^b	54.1	73.0	80.0	79.5
Hatching Success (%)	35.3	39.2	54.6	49.4
Fledgling Success (%)	23.4	55.0	32.3	44.9
Fledge Ratio ^c	0.69	1.26	0.59	0.86

^a total number of nests hatched/total number of nests initiated

^b total number of nests hatched/ total number of nests initiated with a known nest fate

^c number of chicks fledged per pair of adults per species

Table 5. Least tern and piping plover nest fates along the Niobrara River in Nebraska during 1996 and 1997.

	<u>Piping Plover</u>		<u>Least Tern</u>	
	1996	1997	1996	1997
Total Nests Found	125	68	217	133
Nests with Known Fate	74	37	145	83
No. Hatched	40	27	116	66
No. Destroyed or Abandoned	34	10	29	17
Cause of Destruction ^a				
Predator	17	0	15	1
Flooding	4	3	0	3
Weather	0	0	1	1
Sandbar Erosion	6	1	12	6
Fate Unknown	51	31	72	50

^a Only major causes are represented in table

Piping plovers typically initiate nests earlier in the summer than least terns with terns being more synchronous nesters than plovers. A large flood peak at the end of May 1996 destroyed all active nests and caused plovers to begin renesting at approximately the same time as terns were beginning their nesting. Due to this short flood spike in 1996, piping plover nest initiation was later, resulting in least tern chicks hatching before piping plovers. This affected the time available for successfully hatched chicks to grow and fledge and for subsequent renesting attempts. During 1997, a more normal year with respect to nest initiations, piping plovers initiated their first nests before least terns, and chicks of both species began hatching out during the same time frame.

Other researchers have reported average clutch sizes of 3.5 to 3.7 eggs/nest for piping plovers (Lingle 1988, Prindiville-Gaines and Ryan 1988) and of 2.3 to 2.6 eggs/nest for least terns (Dryer and Dryer 1985, Niemi and Davis 1979, Smith and Renken 1991). Clutch sizes on the Niobrara for both species were almost identical to the findings of other researchers. Success of piping plovers nests has been reported between 25 - 83.5% (Dirks 1990, Kruse 1993, Patterson et al. 1991) while least tern nest success varies between 36 - 69% (Dirks 1990, Kruse 1993, Renken and Smith 1993). My nest success rates for known fate nests of both terns and plovers for 1996 and 1997 (54% piping plovers 1996, 73% piping plovers 1997; 80% least terns 1996 and 1997) equaled or exceeded rates reported in other studies.

Most piping plover and least tern nests are destroyed by predators (Dirks 1990, Kruse 1993) or by inundation (Lingle 1993). Patterson et al. (1991) found that 91% of nest losses were attributable to predation while Dryer and Dryer (1985) determined that

the two major threats to least tern reproduction were disturbance and inundation. This corresponds to my findings on the Niobrara River. However, on the Niobrara River, sandbar erosion was another factor that resulted in increased nest losses. Large islands continuously eroded away in the later part of the summer due to decreased flows and spreading of the river channel. This resulted in erosion of nest sites and reduced the amount of habitat available on which chicks could evade predators or forage.

Fledgling success of least terns and piping plovers can vary from 13% to 88% (Dirks 1990, Goossen 1990). The Niobrara River was approximately mid-point in this range with 36 - 37%. This lower rate may be due mainly to predation by avian predators, such as great horned owls, which dramatically increased during the brood-rearing period. Other avian and mammalian predators including great blue herons and mink also contributed to the large losses of adults, chicks, and nests (Kruse 1993). Flooding and sandbar erosion also contributed to chick loss which reduced fledgling success.

Based on my results, piping plovers and least terns were able to nest and rear young fairly successfully along the Niobrara River in 1996 and 1997. These findings suggest the apparent increases in population status since the 1981 census was perhaps due to recruitment from the nesting birds and not solely by birds displaced from other areas of the northern Great Plains. However, the high flows of the Missouri River during 1996 and 1997 probably contributed a number of birds to the Niobrara River population. A survey should be completed during a year of good habitat on the Missouri River to assess what portion of my findings were actually resident nesters and not refugees.

CHAPTER 3. HABITAT USE AND CRITERIA FOR LEAST TERN AND PIPING PLOVER SELECTION OF NESTING SITES

INTRODUCTION

Mapping and measuring or estimating area and characteristics of various habitat types on multiple sample sites is frequently unattainable with conventional botany and ecology field techniques. Limitations are usually related to time and labor necessary to complete the tasks in large scale studies. Thus, I attempted to determine characteristics of used and unused sandbar/islands with conventional and with aerial videography techniques. All measurements were related to nest sites or to nesting colony sites (used and unused).

Aerial videography is becoming more prevalent in its use as a tool in remote sensing of wildlife habitats. Natural color video cameras are relatively inexpensive and their use enables an observer to classify habitats easily (Seibert et al. 1996). The resolution of S-VHS videography is now comparable to many types of aerial photography. The mean of the percent difference between areas classified from aerial videography or photography was $1.54 \pm 0.26\%$, range = 0.03-6.69% (Seibert et al. 1996). This small percent difference, coupled with ease of use and immediate availability of videography, makes it a creditable choice for use with large expanses of wildlife habitat (Sidle and Ziewitz 1990). Natural color videography also presents habitats in their correct colors enabling accurate ground-truthing and multiple coverages per season (Seibert et al. 1996).

Aerial videography can skillfully be used to classify multiple habitat types in any given image as well as create models for flow and habitat relationships. These

classifications can then be used to find area, perimeter, distances, and other measurements of interest (Sidle and Ziewitz 1990, Fairbanks et al. 1993). Once a single image is classified, the classification can be extrapolated for use with other images from the same flight and from past or future flights. Videography is a highly cost effective way of frequently obtaining information about an area and with good success.

METHODS

Substrate texture and moisture, percent coverage of vegetation canopy, vegetation height, distance from water (m), and elevation above water to the nearest centimeter (cm) were measured for a sample of nests during the 1996 and 1997 field seasons. Nesting substrate was either determined to be damp/wet sand or dry sand due to the degree of moisture and compaction. Substrate texture at each nest was defined as either fine sand, coarse sand, gravel, or silt/mud. Percent canopy coverage of the ground by vegetation was visually estimated to the nearest 5% in a 1 m radius of each nest. Height of vegetation within 1 m of each nest was determined by visual estimation and periodically validated with a ruler. Nest distance from the water was measured using a 100 meter tape. A line and level technique was used to determine each nest's elevation above the water.

Geomorphometric characteristics were determined in 1996 for a sample ($n = 37$) of sandbars where successful nesting and brooding occurred. These characteristics were also determined in 1997 for a sample ($n = 16$) of sandbars where successful nesting and brooding occurred and for a sample ($n = 15$) where nesting and brooding did not occur. Habitat variables such as shape of the sandbar, its location in relation to channel

morphology, percent total vegetative cover on the sandbar, species of vegetation, and the approximate mean vegetation height were determined for each sandbar/island. All measurements and estimates of geomorphometric and habitat characteristics were obtained by both conventional techniques and with aerial videography techniques. Other documented variables included the percent of the total island area covered with wet sand and the percent substrate composition by area of the total island area.

Aerial videography of the Niobrara River was acquired twice during the 1996 season and once during the 1997 season for the period corresponding with pre-nesting and nesting of the least terns and piping plovers (Kirsch 1996). The first flight in 1996 was done on 23 April and the second flight was flown on 8 June. The only flight in 1997 was flown on 1 June. These videos of the Niobrara River are representative of the spring and the habitat available as piping plovers and least terns enter the breeding grounds and begin nest initiation. All aerial videography was contracted with a certified pilot, John G. Sidle, U.S. Forest Service, Chadron, NE.

For the 1997 field season, the same variables were measured with conventional and aerial videography techniques in 1996 plus measurements were taken on the presence or absence of heavy vegetation areas and the percent of the sandbar they covered for each island. The percent of high sand in relation to low sand over the total island area was also estimated. All geomorphometric characteristics as well as the other characteristics listed above were recorded on standardized data sheets for the 1996 and 1997 field seasons (Appendix B).

During the 1997 field season, pairs of systematically selected islands, half with and

half without nesting colonies of least terns or piping plovers were also evaluated. For each island that supported a nesting least tern or piping plover, an unused island was selected by choosing the first potentially habitable island downstream from the nesting island. Potentially habitable was defined as an island above water, high enough and large enough to support nesting birds.

From the 1997 videography, we captured 29 images of sandbars on the Niobrara River as Targa files using a TARGA video capture board, a VHS/S-VHS video player/recorder (VCR), monitor and Gateway2000 P5-120 computer. These 256 shade color images were converted to monochrome images in SigmaScan and saved as Tiff Files. These Tiff Files were then imported into Arc/Info where they were converted into a grid with each cell being equivalent to a 1.3 m by 1.3 m or 1.7 m² /pixel. The grids were then polygonized to raster coverages. A short program was then written to select pixels with similar reflective values from these raster coverages and also combine them as multiple pixel polygons. This produces a very complex image because each pixel has a different reflective value. A supervised classification of reflective values was performed on all coverages. The supervised classification selected the values that represented 5 habitat groups. These were high sand, low sand, wet sand, water, and vegetation. Each of these general habitats was assigned a range of values based on the range of reflectance values that corresponded to it. Polygons were then dissolved to produce a general habitat map for each site.

Scale for interpretation of polygon images was determined by measuring bridges of known length. The length of each bridge was calculated in pixel units from which a

conversion factor was developed to change image units to meter units. The conversion factor was determined by finding the length of one side of a pixel in image units and then converting to meters. This conversion factor was then used to calculate distance. So the image was scaled based on known bridge lengths and a constant flight height was assumed during the recording of the videography. The conversion factor for the 1997 videography was 1 image unit² equaling 149,000 m² or 14.9 hectares (ha).

The same general steps were taken for the 31 island images captured from the 1996 aerial videography. However, because the color of the videography was not uniform, short programs could not be written to select pixels with like reflective values and further combine them as a multiple pixel polygon. This procedure was done manually by hand with the aid of a computer. Once, a classification of the gray scale images was accomplished the same measurement conversion procedures were followed as for the 1997 data. The conversion factor for the 1996 videography was 1 image unit² equaling 143,641 m² (14.36 ha²) for reach 1; 148,225 m² (14.82 ha²) for reach 2; 160,801 m² (16.08 ha²) for reach 3; 210,681 m² (21.06 ha²) for reach 4; 191,844 m² (19.18 ha²) for reach 5; 120,409 m² (12.04 ha²) for reach 6; and 106,276 m² (10.63 ha²) for reach 8.

These polygon scales enabled determination of the area of each island as well as the area of specific habitat types (high sand, low sand, wet sand, and vegetation) and the percent composition of each habitat type in hectares (ha). High sand was defined as a white sand category on the aerial videography, while low sand was various shades of light to medium gray and wet sand was sand with water over it or damp sand in shades of dark gray. Vegetation was a variety of extremely dark grays and blacks. This technique can be

used to obtain other polygon measurements from the islands that may be useful in other studies. These measurements could include distance from shore and/or characteristics of the surrounding landscape.

Historic hydrographic information available for the Niobrara River was also compiled. This information was used to study the chronology of flows and availability of historic piping plover and least tern habitats. United States Geological Service gage stations were used to collect data on water flow discharge and gage heights of the Niobrara River at the Verdel and Spencer stations. These data were obtained through the U.S. Army Corps of Engineers, Missouri River Division, Omaha, NE.

Statistical analyses

Logistic regressions were run on the 1997 data comparing islands used by piping plovers and least terns for nesting to islands not used by either species for nesting. Islands used only by piping plovers were also compared against islands where piping plovers nested with least terns 1996 and 1997. Possible reasons for nest success or failure in 1996 and 1997 were evaluated for these different island types by logistic regression and frequency tables.

Descriptive statistics were run on the classified aerial videography images using the computer software Arc/Info on a UNIX station. These statistics gave total area of the island, heavy vegetation associated with the island, high sand, low sand, and wet sand in square meters (m²). SYSTAT 7.0 and SAS (statistical analysis software) were used for the generation of more extensive statistics. This included running paired t-tests on paired islands, principal component analyses, two-sample t-tests, and stepwise-logistic

regression. These statistics were used to determine what variables could be used to predict use or non use of an island. Paired t-tests were corrected using Bonferroni correction for alpha level 0.10. For the 1997 field season, logistic modeling was also performed on part of the data. Modeling is beneficial to compare the natural flows and braided channel of the Niobrara River with the more controlled and channelized flows of the Missouri River.

RESULTS

Nest Sites

Characteristics of individual nests as well as the entire sandbar/island were documented on the Niobrara River. Of the 543 nests initiated in 1996 and 1997, a total of 278 nests (84 piping plovers; 194 least terns) were initiated in dry sand and 263 nests were initiated in wet sand (109 piping plovers; 154 least terns). Two nests were not assigned to habitat characteristics. Five hundred and forty-one nests were initiated on either fine sand substrate (152 piping plovers; 291 least terns), coarse sand (29 piping plovers; 54 least terns), gravel (11 piping plovers; 3 least terns), or silt/mud (1 piping plover; 0 least terns) (Table 6). Nest fate was compared against the nesting substrate. For 1996 islands, there were no significant differences between the type of substrate piping plovers or least terns initiated their nests on and the fate of the nest. In 1997, there was again no significant difference for the nest fate of piping plovers by substrate type but least terns had higher hatched nest fates on fine sand as opposed to coarse sand.

The percent of vegetation within 1 meter squared (m^2) of a nest bowl was from 0% to 40% (0-35% piping plovers; 0-40% least terns) for nests initiated in 1996 and 1997

Table 6. Mean percent of substrate types and moisture content (SE) by visual estimation for 1996 and 1997 piping plover and least tern nests on the Niobrara River, NE.

	1996		1997	
	Piping Plover	Least Tern	Piping Plover	Least Tern
Fine Sand	81.6	88.5	73.5	75.6
Coarse Sand	12.8	10.1	19.1	24.4
Gravel	4.8	1.4	7.4	0.0
Silt/Mud	0.8	0.0	0.0	0.0
Wet Sand	1.6 (0.04)	1.5 (0.03)	1.4 (0.06)	1.4 (0.42)

with means for both species in 1996 and 1997 between 1% and 3%. The height of the vegetation within 1 m² of nests typically ranged from 0 cm to 50 cm for piping plovers and least terns (Table 7). The mean height of vegetation within 1 m² of a nest was 5 cm for terns and 5 cm for plovers in 1997. However, in 1996 the mean height of vegetation surrounding nests was lower (\bar{x} = 1.6 cm for least terns and \bar{x} = 3.7 cm for piping plovers.)

Of the 543 nests initiated in 1996 and 1997, a total of 171 were measured for their distance from the water's edge and their elevation above the water's surface (72 piping plover nests; 99 least tern nests). Nest distance from the water varied between 0.2 m to 75.0 m for piping plovers and least terns. The median nest distance from the water was 22.5 m in 1996 and 16.5 m in 1997 for least tern nests and about 18.0 m away from the water for piping plovers. The height of the nests above the water ranged from 2.5 cm to 91.4 cm for piping plovers and least terns while the median height above water for nests was between 22.9 cm and 35.6 cm (Table 8).

Colony Sites

Fifty-three sandbars (37 in 1996; 16 in 1997) were used by least terns and/or piping plovers for nesting colonies on the study area. In 1997, 15 additional sandbars, not used by either species, were also surveyed. The percentage of wet sand on a sandbar/island, as measured by visual estimation, was between 48% and 67% for both years (59.3% in 1996; 48.1% on used islands in 1997; 67.3% on unused islands in 1997). The median values for the percentage of wet sand area on an island were 65% for 1996

Table 7. Mean percent vegetative cover (SE) and mean vegetation height (SE) (cm) by visual estimation for 1996 and 1997 piping plover and least tern nests on the Niobrara River, NE.

	1996		1997	
	Piping Plover	Least Tern	Piping Plover	Least Tern
Vegetative Cover	3.41 (0.62)	1.73 (0.35)	1.37 (0.31)	1.13 (0.24)
Vegetation Height	3.72 (0.77)	1.65 (0.32)	2.71 (0.57)	1.78 (0.32)

Table 8. 1996 and 1997 nest elevations (cm) and distances (m) from the water for least terns and piping plovers on the Niobrara River, NE.

	1996			1997		
	Min.	Mean (SE)	Max.	Min.	Mean (SE)	Max.
Piping Plover						
Distance	1.9	22.7 (1.56)	75.0	4.0	22.2 (1.90)	65.0
Elevation	6.4	30.6 (0.65)	91.4	2.5	33.8 (1.77)	55.8
Least Tern						
Distance	2.0	25.9 (1.05)	59.5	0.2	17.6 (0.88)	44.0
Elevation	7.6	31.8 (0.41)	76.2	5.1	33.2 (1.29)	81.3

and 45% for used islands in 1997 and 80% for unused islands in Table 9.

Substrate types which occurred on sandbars both years include gravel, coarse sand, fine sand, and silt/mud (Table 9). Sites nested on by piping plovers and least terns in 1996 and 1997 had a median value of 80% fine sand substrate, up to 5% gravel, up to 10% coarse sand, and 10% silt/mud. A significant factor in determining use of an island included the percent of gravel on a sandbar. Sites used for nesting by least terns and piping plovers had significantly ($t = 3.778$, $df = 14$, $p = 0.002$) more gravel than did unused sites when compared by paired t-tests. Even though gravel made up only a small portion of the available substrate materials it was highly selected for nesting.

For 1996 and 1997, the mean percent total vegetative cover, measured by visual estimation, was approximately 25% for 1996 nesting islands (used) (25.5%), 1997 nesting islands (used) (25.4%), and 1997 unused islands (25.1%). The median percent vegetative cover for 1996 was 20% while for 1997 used islands it was only 5% but ranged from 0% - 95% over both years. The median percent vegetative cover for unused 1997 sandbars was 15% (Table 10). The mean height of vegetation on used sandbars varied considerably from 1996 (20.4 cm) to 1997 [13.4 cm 1997 (used); 7.0 cm (unused)] ranging between 0 and 100 cm.

For the 1997 sites, 3 additional variables were recorded including the presence or absence of heavily vegetated areas on the nesting island, the percentage of island area covered by these patches, and the percent of low sand on the island in relation to the amount of high sand. Heavily vegetated patches usually consisted of tall [>1.5 m (5 ft)] willows (*Salix* sp.), cattails (*Typha* sp.), as well as trees and shrubbery depending on the

Table 9. Mean percent substrate types (SE) and moisture content (SE) from visual estimates for 1996 and 1997 piping plover and least tern island colony sites as well as for 1997 comparison islands on the Niobrara River, NE.

	1996 Used ^a	1997 Used ^a	1997 Unused ^b
Fine Sand	75.42 (3.73)	70.94 (3.59)	81.07 (2.57)
Coarse Sand	8.83 (2.84)	15.00 (2.52)	5.33 (1.27)
Gravel	2.69 (1.25)	5.44 (0.95)	1.33 (0.54)
Silt/Mud	13.14 (2.29)	8.63 (1.08)	12.33 (2.56)
Wet Sand	59.31 (4.93)	48.13 (4.94)	67.33 (5.92)
Low Sand	N. A.	50.57 (5.10)	78.93 (4.90)

^a Used denotes islands used by piping plovers and/or least terns for nesting.

^b Unused denotes comparison islands monitored without piping plover or least tern nesting.

Table 10. Mean percent vegetative cover (SE), mean vegetation height (SE), and percent of heavy vegetation (SE) from visual estimation for 1996 and 1997 piping plover and least tern nesting sites as well as for 1997 comparison islands on the Niobrara River, NE.

	1996 Used ^a	1997 Used ^a	1997 Unused ^b
Vegetative Cover	25.49 (3.91)	25.38 (6.14)	25.07 (5.19)
Vegetative Height	20.38 (4.19)	13.44 (4.35)	7.00 (1.20)
Heavy Vegetation	N. A.	17.81 (4.51)	6.33 (2.94)

^a Used denotes islands used by piping plovers and/or least terns for nesting.

^b Unused denotes comparison islands monitored without piping plover or least tern nesting.

sandbar or island size. This type of heavy vegetation allows sandbars to form downstream and adjacent to the island as a result of the annual Niobrara River floods. Flood waters are slowed by the dense vegetation and drop their sediment load (typically the coarser sands) creating new or building up existing sandbars. For sites used by piping plovers and least terns for nesting, 6 (40%) had no heavy vegetation using visual measurements while 9 (60%) had heavily vegetated areas. For unused sites, 3 (21%) contained heavily vegetated sites while 11 (79%) did not. The percent area (17.81%) of islands with heavy vegetation associated and used by plovers and terns was almost triple the percent area (6.3%) for unused islands (Table 10). The percent of heavy vegetation on a nesting island ranged from 0% to 74.5%. Stepwise multiple logistic regression resulted in a model where the percent of heavy vegetation was the variable of interest ($p = 0.060$). The percentage of coarse sand on an island was also correlated with the percent of heavy vegetation (Pearson Correlation Coefficient = 0.64198, $p = 0.0002$, $n = 29$). The mean percent of low sand (50.6%) for used islands in 1997 was much lower than the percent of low sand (78.9%) on 1997 unused islands with the median being 50% on used islands and 87.5% on unused islands in 1997. This variable is highly correlated to the percentage of wet sand on an island (Pearson Correlation Coefficient = 0.61, $p = 0.0006$, $n = 29$) therefore, it was not explored beyond descriptive statistics.

Of the 37 islands least terns and piping plovers nested on in 1996, a total of 32 were visible on aerial videography; the other 5 were obscured by clouds or plane movements and could not be used to obtain measurements. All 16 of the sandbars used by piping plovers and least terns in 1997 and 13 of the 15 unused comparison islands were

visible in the aerial videography.

Of sandbars used by piping plovers and least terns in 1996 and 1997, the total surface area (ha) above water varied between 0.24 ha to 38.95 ha (0.24 - 38.95 ha in 1996; 3.33 - 31.45 ha in 1997). The mean size of islands in 1996 were similar to those in 1997 (Table 11). The size of the sandbar was also significant ($p = 0.009$) in predicting the number of nesting piping plovers on a sandbar using stepwise logistic regression. The amount of high sand typically on a sandbar used for nesting was between 0.0 ha and 7.29 ha. Mean values were similar between years while the median value was much smaller in 1996 than in 1997 (Table 11). The portion of high sand, low sand, and wet sand on a sandbar have not been completely analyzed by other researchers. Ziewitz et al. (1992) documents only what is defined as usable sand, this being any sand appearing on the aerial videography as light colored. In my aerial videography, I had sufficient knowledge of the river to classify not only vegetation and high sand but low and wet sand as well. By comparing islands used by piping plovers and least terns for nesting in 1997 and unused 1997 islands, the hectares of high sand on an island can be used to determine use of an island by least terns or piping plovers. Piping plovers use of an island was correctly classified 68.1% of the time ($p = 0.010$) and least terns 62.0% of the time ($p = 0.026$). Using frequency tables, it was determined that an island with an area greater than or equal to 1 ha of high sand was used 66.7% of the time for nesting by piping plovers ($p = 0.014$) and least terns ($p = 0.047$) as opposed to islands with < 1 ha of high sand. Paired t-tests showed that the amount of high sand estimated from aerial videography was significantly greater for nesting islands than the amount of high sand on unused islands ($t = 3.221$, $df =$

Table 11. Mean values (ha) and mean percentages of composition for island colony site characteristics measured from aerial videography for 1996-1997 on the Niobrara River, NE.

	1996 Used ^a		1997 Used ^a		1997 Unused ^b	
	Mean (SE)	% (SE)	Mean (SE)	% (SE)	Mean (SE)	% (SE)
Total Hectares	11.3 (1.84)	N. A.	13.0 (2.00)	N. A.	7.2 (1.81)	N. A.
High Sand	0.3 (0.15)	1.5 (0.50)	2.3 (0.50)	21.3 (4.23)	0.5 (0.17)	10.3 (4.25)
Low Sand	1.5 (0.35)	13.5 (2.83)	2.8 (0.39)	24.5 (3.33)	2.1 (0.59)	27.6 (4.48)
Wet Sand	6.0 (0.82)	64.2 (4.40)	6.1 (1.27)	42.6 (6.24)	3.1 (0.94)	51.8 (8.19)
Heavy						
Vegetation	3.5 (1.21)	19.6 (4.52)	1.8 (0.94)	11.6 (3.88)	1.5 (8.85)	10.4 (5.54)

^a Used denotes islands used by piping plovers and/or least terns for nesting.

^b Unused denotes comparison islands monitored without piping plover or least tern nesting.

12, $p = 0.007$). Low sand on nesting islands varied from 0.0006 ha to 8.86 ha. The median and mean values for high sand area in 1996 were larger than the 1997 values (Table 11). The amount of wet sand on islands used for nesting ranged from 0.24 ha to 17.86 ha. Mean high sand area values for 1996 and 1997 were approximately the same while median values for 1996 were again smaller than in 1997 (Table 11).

Sandbars used for nesting were either devoid of patches of heavy vegetation or had up to 25.93 ha of heavily vegetated areas in 1996 and 14.99 ha in 1997. Mean area values for heavy vegetation in 1996 were larger than for 1997 with median area values being lower in 1996 than in 1997 (Table 11). The amounts of low sand, wet sand, and heavy vegetation were not statistically different between used and unused bars. However, when a stepwise linear regression was run for island use by least terns, the amount of low sand on an island was significant ($p = 0.042$) for predicting the number of tern nests.

The percentage of habitat for each substrate type was also measured for islands used by piping plovers and least terns. The percentage of high sand typical of used islands was between 1.3% and 69.1% in 1996 (0 - 12%) and 1997 (1.3 - 69.1%). The median and mean values were both lower in 1996 than in 1997 (Table 11). The percent of low sand on the used sandbars was between 0.3% and 67.6% (0.26 - 67.6% in 1996; 6.9 - 48.8% in 1997). The mean and median values in 1996 were again much lower than in 1997 (Table 11). Percentages of wet sand on the sandbars ranged from 7.4% to 90% (18.4 - 99.7% in 1996; 7.4 - 89.9% in 1997). Mean and median values repeatedly were lower in 1996 than in 1997 (Table 11). The percent coverage of heavily vegetated areas associated with nesting islands was from 0% to 74.5% of the sandbar size (0 - 74.5% in

1996; 0 - 47.7% in 1997). However, the mean and median values for the amount of hectares in heavy vegetation was approximately the same for 1996 and 1997 (Table 11).

In 1997, sandbars were measured that did not support nesting birds of either species to compare against nesting islands. These unused sandbars were generally smaller than used bars. The amount of high sand on unused islands varied from 0 ha to 2.07 ha and represented from 0% to 55.5% of the sandbar. The amount of low sand available on 1997 unused sites ranged from 0.02 ha to 6.73 ha and was between 7% to 54% of the sandbar. The amount of wet sand on an unused island varied from 0.024 ha to 6.73 ha encompassing 11% to 92% of the sandbar. Heavily vegetated portions of the islands were from 0 ha to 9.56 ha in size covering up to 58% of the sandbar.

All median and mean values for 1997 unused islands were lower than the corresponding median and mean values for 1997 used islands (Table 11). In general, 1996 nesting sandbars minimum values were lower and maximum values were higher than 1997 sandbars. Habitat characteristics of sandbars used by piping plovers were extremely similar to and often overlapped the characteristics of islands used by least terns (Table 12). When comparing islands with only piping plover nests to islands with least tern and piping plover nests with stepwise logistic regression, the percent of vegetative cover on an island was significant ($p = 0.048$). This indicates that islands with both species nesting have less vegetative cover than islands with only piping plovers nesting. When comparing generally used or unused islands for piping plovers, the main variable of influence is the percent of heavy vegetated area on the island. Stepwise logistic regression indicated that least terns are 32 times more likely to nest on an island with piping plover nests than without them.

Table 12. Characteristics (ha) of islands used by piping plovers and least terns for nesting from 1997 aerial videography on the Niobrara River, NE.

	Piping Plover		Least Tern	
	Mean (SE)	Median	Mean (SE)	Median
Total Hectares	13.6 (2.0)	12.9	13.6 (2.5)	11.7
High Sand	2.4 (0.5)	18.2	2.4 (0.6)	1.8
Low Sand	2.9 (0.4)	25.3	2.8 (0.5)	2.2
Wet Sand	6.5 (1.3)	6.1	6.4 (1.7)	5.6
Heavy Vegetation	1.9 (1.0)	0.4	2.0 (1.2)	0.2

Least terns were also found to be associated with higher islands since the maximum height of an island was significant when comparing islands with tern nests and without tern nests ($p = 0.020$).

I attempted to reduce the number of habitat variables by using factor analysis. This described the amount of variation as due to 3 factors: 1) elevation (32.0%); 2) size (37.7%); 3) substrate (20.5%). These factors explained 90.2% of the variance. There were no significant difference between islands with least terns and islands without least terns but there were significant differences for islands with piping plovers and without piping plovers. Islands with only piping plovers had lower amounts of fine sands were as islands with both least terns and piping plovers nesting had higher amounts of fine sands ($p = 0.03$).

DISCUSSION

Least terns initiated more nests on dry sand than on wet or damp sand in 1997 (81 dry; 50 wet) and in 1996 (113 dry; 104 wet). Piping plovers nested almost equally on wet and dry sand in 1997 (38 dry; 30 wet) but in 1996, 63% of initiated nests were on wet sand (46 dry; 79 wet). Nests were initiated on dry sand early in the season and on wetter sand as the season progressed. Renests were commonly on damp or wet sand. Most researchers have not documented the moisture condition of the terns and plovers nesting substrate. However, substrate moisture seemed to be important for birds nesting later in the summer and for renests as more nests were initiated later in the season on wet than dry sand. In later nests, this may be the result of selection. Two possible explanations are than 1) wetter sand may keep the eggs cooler during the hottest part of the summer or 2)

areas with wetter sand may be the only remaining territories available for renesting pairs and late nesters. The large number of piping plover nests initiated on wet sand in 1996 may be due to the large flood event during the early part of the nest initiation time period.

Fine sand substrates were used more frequently than coarse sand, gravel, and silt/mud for nest initiation sites by both species along the Niobrara River. Nesting success was also higher for nests with fine sand substrates than for other substrate types. Fine sand substrates were also more common on the majority of nesting sandbars than the other substrates. Schwalbach (1988) found that fine sands were important in determining potential nesting sites while Whyte (1985) determined that piping plovers used gravel for nesting sites more often than would be expected by chance. When a Niobrara River sandbar did contain coarse sand or gravel patches, piping plovers seemed to select them for nesting. Researchers have found that least terns commonly initiated nests on 80-90% bare ground with fine sands, and piping plover commonly initiated nests on areas with larger substrate size than least terns (Faanes 1983, Dryer and Dryer 1985, Gochfeld 1983).

Least terns and piping plovers nested 98% and 92% of the time respectively, in areas with 15% vegetation coverage or less in 1996. In 1997, terns and plovers nested in areas with 15% vegetation coverage or less 100% of the time. Piping plover nests are typically initiated in areas with less than 25% vegetative cover (USFWS 1988) but can be found in areas with up to 65% vegetative cover (Dirks 1990). Least terns are usually found in areas with vegetative cover from 0% to 40% (Dirks 1990) whereas Schwalbach (1988) found nests for both species only on sites with less than 10% vegetative cover.

Plovers and terns nesting on the Niobrara River nested in areas with average percentages of vegetation being < than 4.0%. However, piping plovers were more tolerant of vegetative cover than least terns.

The percent area of total heavy vegetative cover on a sandbar/island represents the amount of dense, permanent vegetation per colony site. This thick vegetation may even at times be large enough to support a small predator population. Other researchers have lumped this type of vegetation with the sparse vegetation that often is found on nesting sites or have not measured it. However, I found that piping plovers were selecting islands with this type of heavy vegetation when I compared 1997 islands with plover nests and islands without plover nests. The amount of heavy vegetation on an island was correlated with the amount of coarse sand on the island. Heavily vegetated patches usually consisted of tall willows (*Salix* sp.), cattails (*Typha* sp.), as well as large trees depending on the sandbar/island size. This type of heavy vegetation slows the annual flood waters of the Niobrara River and allows sandbars to form downstream and adjacent to the heavy patches of vegetation. These types of sandbars typically were made of coarse sands and gravel, first to be dropped by the river as it slows. Paired t-tests showed that the amount of high sand estimated from aerial videography and the percent of gravel estimated by conventional means were significantly greater for nesting islands than on unused islands.

The mean height of vegetation within 1 m² of the nest bowl was considerably less in 1997 than in 1996 for both species. Least terns nested in areas with shorter vegetation (1996 \bar{x} = 7.0 cm; 1997 \bar{x} = 6.0 cm) than did piping plovers (1996 \bar{x} = 10.1 cm; 1997 \bar{x} = 6.3 cm) according to the mean height of vegetation around their nests. Least terns

avoided initiating nests within vegetative cover to a greater degree than piping plovers but vegetation often grew up around these nests after nest initiation. Other researchers have found maximum average heights of vegetation on colony sites of 32 cm and typically ranging from 1 cm to 20.5 cm in height at nests for both species (Carreker 1985, Kotliar and Burger 1986, Niemi and Davis 1979).

The average distance nests were initiated from the waters edge was considerably less in 1997 than in 1996 for least terns (1996 \bar{x} = 25.9 m; 1997 \bar{x} = 17.6 m). For piping plovers, the distance from water was similar in 1996 and 1997 (1996 \bar{x} = 22.7 m; 1997 \bar{x} = 22.2 m). Faanes (1983) recorded piping plovers nesting 16 m and least terns nesting 19 m away from the water for islands on the Platte River, Nebraska. On the Missouri River, piping plover nests were from 5.8 m to 35.8 m away from the water while least tern nests ranged from 4.9 m to 27.2 m away (Schwalbach 1988). Nests on the Niobrara River were usually further away from the water than reported in other studies. Nests are typically well away from the water's edge since they are initiated when river flows are high and very little sand was exposed, subsequently when the water level drops, nests are literally left high and dry (USFWS 1990). Faanes (1983) found piping plovers nesting closer to the water than least terns. The Niobrara River followed that pattern for 1996 but 1997 showed the opposite.

Nest elevations were similar between years for both species. Least tern nests averaged 32 to 33 cm above the water, whereas piping plover nests averaged 31 to 34 cm above the water, well within values stated by other researchers. Piping plover nest elevations found by other researchers have ranged from 1.3 cm to 73.5 cm above the

water (Dirks 1990, Schwalbach 1988). Least tern nest elevations varied between 1.5 cm and 118.3 cm in areas sampled by Dryer and Dryer (1985).

Other researchers have found sandbar size to be extremely variable. Terns and plovers have been found nesting on sandbars from 0.2 ha to 5.1 ha in size with a mean of 1.8 ha (Dryer and Dryer 1985, Schwalbach 1988). In North Dakota (Dryer and Dryer 1985), the size of used islands ranged from 0.9 to 1.1 ha while sites not used varied from 0.9 to 2.8 ha in size. Ziewitz et al. (1992) found that the mean sandbar area for nesting sites was 1.9 ha and 0.5 ha for used islands in 2 different portions of the Platte River, while the means for unused sites in their systematic sample were 0.8 ha and 0.2 ha. My findings were similar to those found by other researchers for the minimum size of an island a plover or tern would use for nesting. Although, the mean size of sandbars (1996 \bar{x} = 11.3 ha; 1997 \bar{x} = 13.0 ha) used for nesting on the Niobrara River in 1996 and 1997 was much greater than means other researchers had detected. Unused sandbars on the Niobrara (only measured in 1997) were also typically greater in size (\bar{x} = 7.2 ha) on the Niobrara River than the bars used by plovers and terns on other rivers. This may be due to the shallow braided characteristics of the Niobrara River producing large sandbars.

CHAPTER 4. CONCLUSIONS AND RECOMMENDATIONS

The natural flows of the Niobrara River make it interesting to study. My findings on the Niobrara River generally correspond with findings on other rivers. However, my data on productivity is among the highest, if not the highest, reported in recent times in the northern Great Plains for known fate nests. These findings suggest that the increases in overall population of piping plovers and least terns along the Niobrara River since 1981 are not solely due to displaced birds from other areas.

The majority of nest site characteristics measured were comparable to other researcher's findings. Of special interest, my data indicated that a higher percentage of nests were initiated in wet sand during the later part of the year. This may reflect the territories available to the late nesting birds and re-nesters or it may be a way to cool the eggs during the hottest part of the summer. Nests of piping plovers and least terns on the Niobrara River were also generally further away from the water than reported in other studies.

Sandbars on the Niobrara River used by piping plovers and least terns for nesting as well as the comparison sandbars in 1997 were all larger in overall size than sandbars and islands measured in other studies. This could be the result of the natural hydrologic regime of the Niobrara River where flows are initially high and large sandbars emerge as the river flows decline. The number of tern and plover nests were both correlated with the overall size of the island. The number of plover nests was also correlated with the amount of high sand available at nest initiation. The number of tern nests was correlated to the number of plover nests. The number of successful nests for both species was also

correlated to the total size of the island and the amount of high and low sand. The amount of high sand in hectares can be used to predict the use of a sandbar by piping plovers and least terns between 62% and 68% of the time. Sites used for nesting by least terns and piping plovers also had significantly more gravel than corresponding unused sites in 1997. Three variables were determined to have a bearing on nest initiation on a particular island; 1) elevation of the island; 2) size of the island; 3) substrate composition of the island.

On the Niobrara River, least terns were found nesting in the company of piping plovers preferentially during 1996 and 1997 while piping plovers showed no preference for nesting with or without least terns. Logistic regression suggested that least terns were selecting for the presence of piping plovers on their nesting islands and then for a decreased amount of nesting area vegetation as well as for increased amounts of high sand. Piping plovers were selecting for islands with areas of heavy vegetation and high percentages of the correlated coarse sand. The piping plover habitat model may be used to determine use or non-use of a sandbar/island since in 1996 and 1997 least terns only nested on two islands without piping plovers. This model could be used to determine use/non-use of sandbar/islands for least terns. The results from the aerial videography indicate that terns are not selecting for a narrower range of values than piping plovers and there seems to be little difference in specific requirements for nesting sandbars.

Piping plovers selected sandbars larger than 3.4 ha with a median size of 12.9 ha. Plovers used islands with more than 0.2 ha of high sand (>1.3% of the total island area and up to 69%) and more than 1.4 ha of low sand (>9% of the total island area and up to 49%) for their nesting islands. Least terns selected sandbars larger than 3.3 ha of habitat

with a median size of 11.8 ha. Terns used islands with at least 0.2 ha of high sand (>1.3% of the total island area up to 69%) and 0.2 ha of low sand (>7% of the total island area and up to 49%) for their nesting islands. The height of the islands above the surface of the water should be at least 15 cm for both species; the median heights of 43.5 cm for piping plovers and 49.5 cm for least terns were prevalent in my study. These recommendations for tern and plover islands are based on the minimum and median values used by both species as they selected nesting islands on the Niobrara River in 1996 and 1997. These figures are minimums. If future nesting island construction is a management activity of an agency, I would suggest the use of median values rather than the minimum values to ensure adequate size of the created sandbar/islands.

During this study, I used conventional methods such as visual estimation for determining most of the habitat variables. I also used aerial videography to evaluate some of the same habitat variables. Results between the two methods were very similar for most of the habitat variables but the visual estimation technique was subject to more observer error. Aerial videography can be extremely helpful in some instances. It reduces disturbance to the birds and colony sites by lessening the time spent collecting data on the island. Another benefit is the ability to cover large areas in a short period of time or repeatedly. The equipment needed to use this technique is now becoming more available as technology increases. Problems do arise with aerial videography. A few of these include the time needed to learn the software needed for data analysis and the ability to find a qualified, available pilot. I originally intended more than one flight a year for the aerial videography of the Niobrara River, however, due to pilot availability I was not able

to have the second flight performed.

I would recommend increased monitoring on smaller braided rivers such as the Niobrara. Instead of only monitoring these rivers during the International Piping Plover Census every 5 years, they should be monitored yearly. This will allow a better understanding of natural hydrography dominated rivers. This monitoring should be done during the middle to end of June. This will correspond to the census time of other agencies and facilitate an accurate count of adult piping plovers and least terns. These smaller rivers may provide prime nesting habitat especially during years when other habitat is unavailable.

LITERATURE CITED

- Bacon, L. M. 1996. Nesting ecology of the interior least tern on the Yellowstone River, Montana. M.S. Thesis, Montana State Univ., Bozeman. 69 pp.
- Bleed A. and C. Flowerday. 1997. An atlas of the Sand Hills.
[Http://csd.unl.edu/csd/illustrations/ra5a/contents.html](http://csd.unl.edu/csd/illustrations/ra5a/contents.html)
- Buchanan, J. P. 1981. Channel morphology and sedimentary facies of the Niobrara River, north-central Nebraska. M.S. Thesis, Colorado State University, Ft. Collins. 126 pp.
- Burger, J. 1984. Colony stability in least terns. *Condor* 86:61-67.
- Cairns, W. E. 1982. Biology and breeding behavior of breeding Piping Plovers. *Wilson Bull.* 94:531-545.
- Carreker, R. G. 1985. Habitat suitability index models: Least tern. U.S. Fish Wildl. Serv. Biol. Rep. 82(10.103). 29 pp.
- Deblinger, R. D., J. J. Vaske, and D. W. Rimmer. 1992. An evaluation of different predator exclosures used to protect Atlantic coast piping plover nests. *Wildl. Soc. Bull.* 20:274-279.
- Dinan, J., R. Lock, and D. Carlson. 1985. Missouri River least tern and piping plover habitat management proposal, presented to the Army Corps of Engineers. Neb. Game and Parks Commission. 5 pp.
- Dinan, J. J. 1996. Least tern and piping plover census in Nebraska. NE Game and Parks Comm. Unpubl. data.
- Dirks, B. J. 1990. Distribution and productivity of least terns and piping plovers along the Missouri and Cheyenne rivers in South Dakota. M.S. Thesis. South Dakota State University, Brookings, SD. 64 pp.
- Dryer, M. P., and P. J. Dryer. 1985. Investigations into the population, breeding sites, habitat characteristics, threats and productivity of the least tern in North Dakota. U.S. Fish and Wildl. Serv. Res. Inform. Paper No. 1, USFWS, Bismarck, ND. Unpubl. ms. 17 pp.
- Ducey, J. E. 1981. Interior least tern (*Sterna albifrons athalassos*). U.S. Fish and Wildl. Serv. 56 pp.

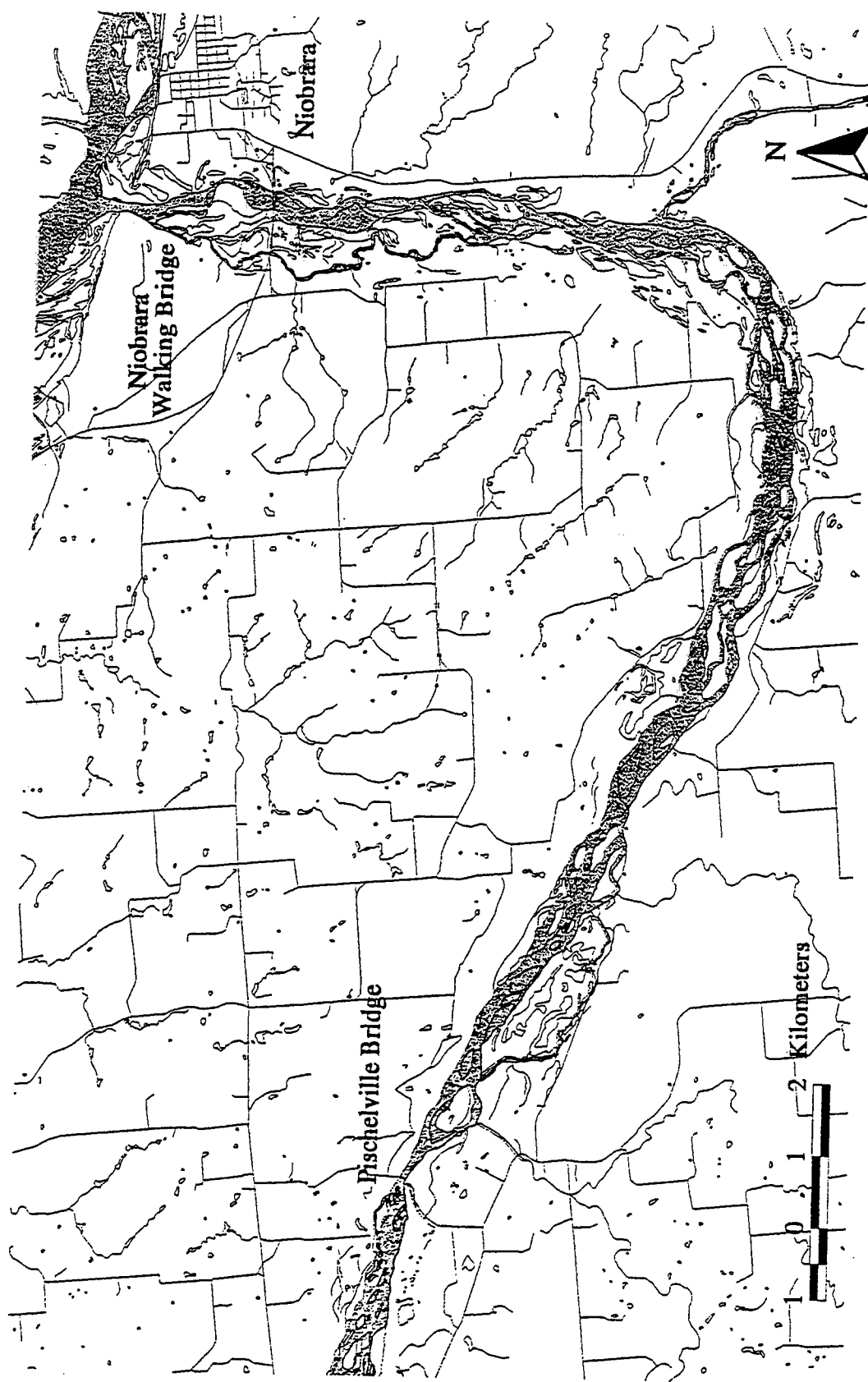
- Ducey, J. E. 1985. The historic breeding distribution of the least tern in Nebraska. *Neb. Bird Rev.* 53:26-36.
- Ducey, J. E. 1989a. Nest scrape characteristics of piping plover and least tern in Nebraska. *Neb. Bird Rev.* 56:42-44.
- Ducey, J. E. 1989b. Birds of the Niobrara River valley, Nebraska. *Trans. Neb. Acad. Sc.* 17:37-60.
- Faanes, C. A. 1983. Aspects of the nesting ecology of least terns and piping plovers in central Nebraska. *Prairie Nat.* 15:145-154.
- Fairbanks, R., C. McShane, D. Latka, and C. Fischenick. 1993. Assessment of Missouri River ten and plover nesting habitat availability using aerial videography and cross-section analysis. Pp 128-129 in K. F. Higgins and M. R. Brashier, eds., *Proceedings, The Missouri River and its tributaries: piping plover and least tern symposium*, South Dakota State Univ., Brookings.
- Gochfeld, M. 1983. Colony site selection by least terns: physical attributes of sites. *Colonial Waterbirds* 6:205-213.
- Goossen, J. P. 1990. Piping plover research and conservation in Canada. *Blue Jay* 48:139-153.
- Haig, S. M. and L. W. Oring. 1987. The piping plover. *Audubon Wildlife Report* pp. 509-519.
- Haig, S. M. and L. W. Oring. 1988. Mate, site, and territory fidelity in piping plovers. *Auk* 105:268-277.
- Haig, S. M. 1992. Piping Plover. *In The Birds of North America, North America, No. 2.* (A. Poole, P. Stettenheim, and F. Gill, Eds.). Philadelphia: The Academy of Natural Sciences; Washington, DC: The American Ornithologists' Union. 17 pp.
- Haig, S. M. and J. H. Plissner. 1993. Distribution and abundance of the piping plovers: Results and implications of the 1991 international census. *Condor* 95:145-156.
- Hays, H. and M. Lecroy. 1971. Field criteria for determining incubation stage in eggs of the common tern. *Wilson Bull.* 83:425-429.
- Higgins, K. F. and M. R. Brashier, ed. 1993. *Proceedings: The Missouri river and its tributaries: Piping plover and least tern symposium.* South Dakota State University, Brookings. 205 pp.

- Kirsch, E. M. 1987. Nesting, population, and foraging ecology of interior least terns and piping plovers on the lower Platte River in Nebraska. Research proposal. Dept. of Zoology, University of Montana. 23 pp.
- Kirsch, E. M. 1996. Habitat selection and productivity of least terns on the lower Platte River, Nebraska. *Wildl. Monogr.* 132:1-48
- Kotliar, N. B. and J. Burger. 1986. Colony site selection and abandonment by least terns *Sterna antillarum* in New Jersey, USA. *Biol. Conserv.* 37:1-21.
- Kreil, R. L., and M. P. Dryer. 1987. Nesting of the interior least tern on the Yellowstone River in North Dakota. *Prairie Nat.* 19:135-136.
- Kruse, C. D. 1993. Influence of predation on least tern and piping plover productivity along the Missouri River in South Dakota. M.S. Thesis. South Dakota State University, Brookings, SD. 80 pp.
- Lingle, G. R.. 1988. Least tern and piping plover nesting ecology along the central Platte River valley, Nebraska. Platte River Whooping Crane Habitat Trust Prog. Rept. 52 pp.
- Lingle, G. R. 1993. Nest success and flow relationships on the central Platte River. Pp 69-72 in K. F. Higgins and M. R. Brashier, eds., *Proceedings, The Missouri River and its tributaries: piping plover and least tern symposium*, South Dakota State Univ., Brookings.
- Mayer, P. M., and M. R. Ryan. 1991. Electric fences reduce mammalian predation on piping plover nests and chicks. *Wildl. Soc. Bull.* 19:59-63.
- Melvin, S. M., L. H. MacIvor, and C. R. Griffin. 1992. Predator exclosures: A technique to reduce predation at piping plover nests. *Wildl. Soc. Bull.* 20:143-148.
- Minsky, D. 1980. Preventing fox predation at a least tern colony with an electric fence. *J. Field Ornithol.* 51:180-181.
- National Park Service. 1995. Draft general management plan environmental impact statement. Niobrara Scenic River Project, Missouri National Scenic Riverways. 125 pp.
- Niemi, G. J. and T. E. Davis. 1979. Notes on the nesting ecology of the piping plover. *Loon* 51(2):74-79.
- Norfolk News. 1964. Rampaging Niobrara River is now tamed, and useful.

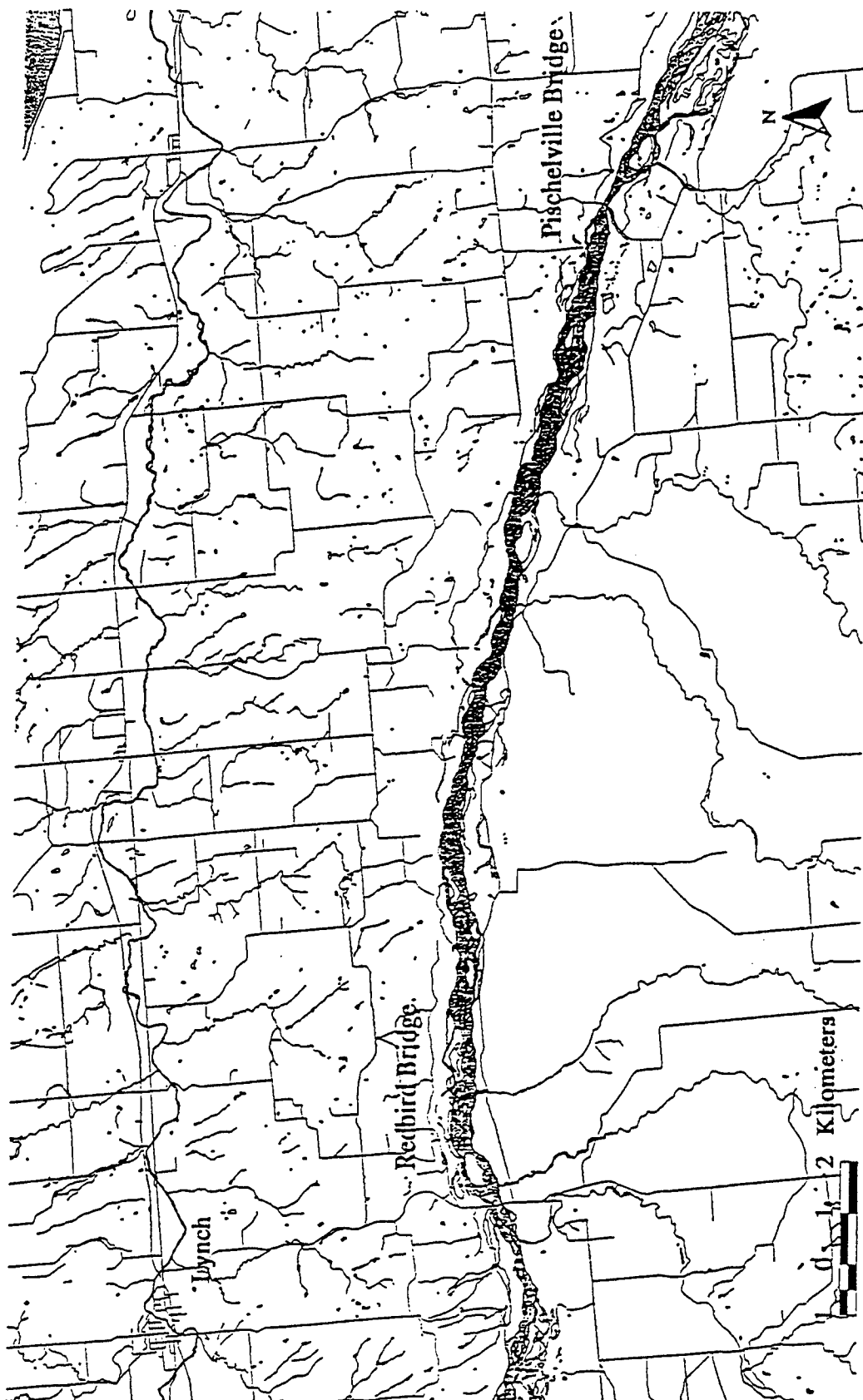
- Patterson, M. E., J. D. Fraser, J. W. Roggenbuck. 1991. Factors affecting piping plover productivity on Assateague Island. *J. Wildl. Manage.* 55:525-531.
- Prindiville-Gaines, E. M. and M. R. Ryan. 1988. Piping plover habitat use and reproductive success in North Dakota. *J. Wildl. Manage.* 52:266-273.
- Renken, R. B. and J. W. Smith. 1993. Productivity and annual adult survival rates of least terns in the Mississippi River valley in and adjacent to Missouri. Pp 66 in K. F. Higgins and M. R. Brashier, eds., *Proceedings, The Missouri River and its tributaries: piping plover and least tern symposium*, South Dakota State Univ., Brookings.
- Rimmer, D. W. and R. D. Deblinger. 1990. Use of predator exclosure to protect piping plover nests. *J. Field Ornithol.* 61:217-223.
- Schwalbach, M. J. 1988. Conservation of least terns and piping plovers along the Missouri River and its major western tributaries in South Dakota. M.S. Thesis, South Dakota State University, Brookings. 93 pp.
- Seibert, T. F., J. G. Sidle, and J. A. Savidge. 1996. Inexpensive aerial videography acquisition, analysis, and reproduction. *Wetlands* 16(2):245-250.
- Sidle, J. G. and J. W. Ziewitz. 1990. Use of aerial videography in wildlife habitat studies. *Wildl. Soc. Bull.* 18:56-62.
- Sidle, J. G., E. C. Wilson, J. J. Dinan, J. Lackey, G. Wingfield, B. K. Good, G. R. Lingle, and R. G. Plettner. 1991. The 1991 census of least terns and piping plovers in Nebraska. *Neb. Bird Rev.* 59:133-149.
- Sidle, J. G., D. E. Carlson, E. M. Kirsch, and J. J. Dinan. 1992. Flooding: Mortality and habitat renewal for least terns and piping plovers. *Colonial Waterbirds* 15:132-136.
- Smith, J. W. 1987. Improving the status of endangered species in Missouri (least tern investigations). MO Dept. of Conserv., Endangered Species Project no. SE-01-12. 39 pp.
- Smith, J. W., and R. B. Renken. 1991. Least tern nesting habitat in the Mississippi River valley adjacent to Missouri. *J. Field Ornithol.* 62:497-504.
- U. S. Army Corps of Engineers. 1987. Biological Assessment: Effects of Missouri River mainstem system operations on the interior least tern and piping plover. Missouri River Division. 43 pp.

- U.S. Fish and Wildlife Service. 1985. Endangered and threatened wildlife and plants; interior population of the least tern to be endangered; final rule. Fed. Register 50(102):21,784-21,792.
- U.S. Fish and Wildlife Service. 1988. Great Lakes and northern Great plains piping plover recovery plan. U.S. Fish and Wildlife Service, Twin Cities, MN. 160 pp.
- U.S. Fish and Wildlife Service. 1990. Recovery plan for the interior population of the least tern *Sterna antillarum*. U.S. Fish and Wildlife Service, Twin Cities, MN. 90 pp.
- Whitman, P. L. 1988. Biology and conservation of the endangered interior least tern: A literature review. U.S. Fish Wildl. Serv., Biol. Rep. 88(3). 22 pp.
- Whyte, A. J. 1985. Breeding ecology of piping plover (*Charadrius melodus*) in central Saskatchewan. M.S. Thesis, Univ. Saskatchewan, Saskatoon.
- Wingfield, G. A. 1978. Breeding status of the interior least tern (*Sterna albifrons athalassos*) in Nebraska. Unpubl. 6 pp.
- Wingfield, G. A. 1984. Niobrara River interior least tern nesting survey - 1984. NE Game and Parks Comm. Unpubl. data.
- Wingfield, G. A. 1988. Niobrara River interior least tern and piping plover nesting survey - 1984. NE Game and Parks Comm. Unpubl. data.
- Ziewitz, J. W., J. G. Sidle, and J. J. Dinan. 1992. Habitat conservation for nesting least terns and piping plovers on the Platte River, Nebraska. Prairie Nat. 24:1-20.

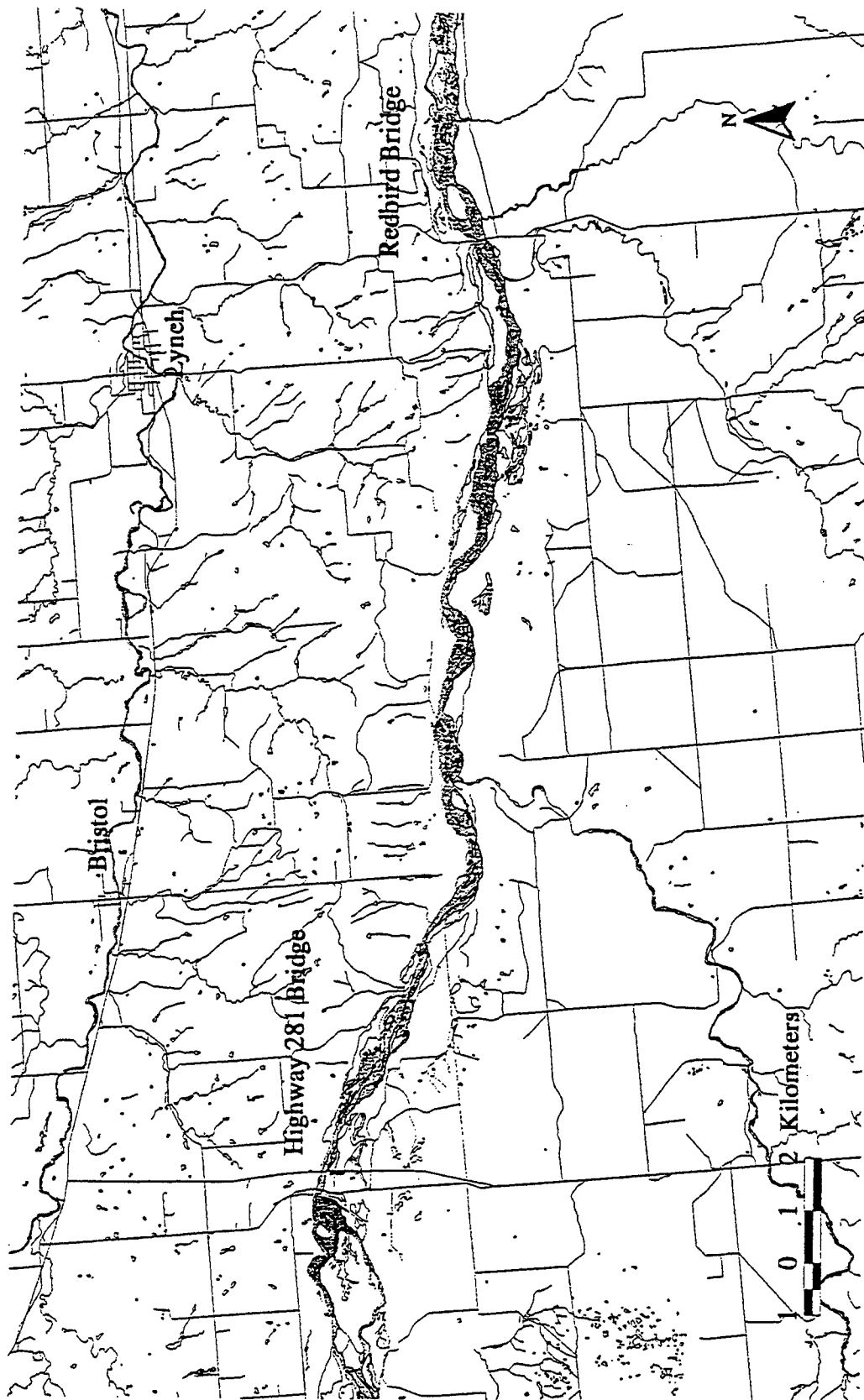
Appendix A. Niobrara River Study Reaches 1 through 11 for 1996 and 1997.



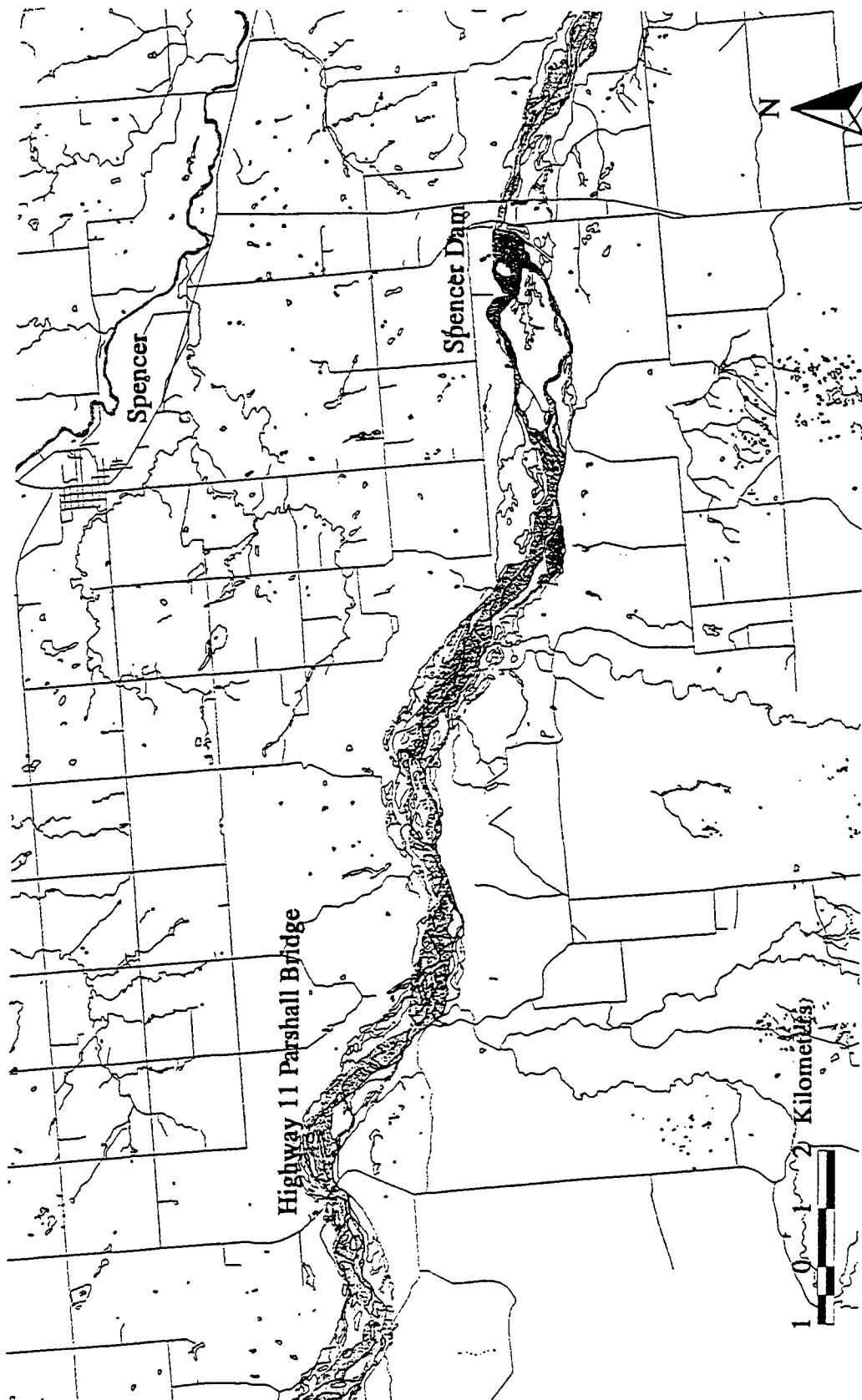
Appendix A. Study Area Reach 1 on the Niobrara River NE, Niobrara Walking Bridge to Pischelville Bridge, 1996



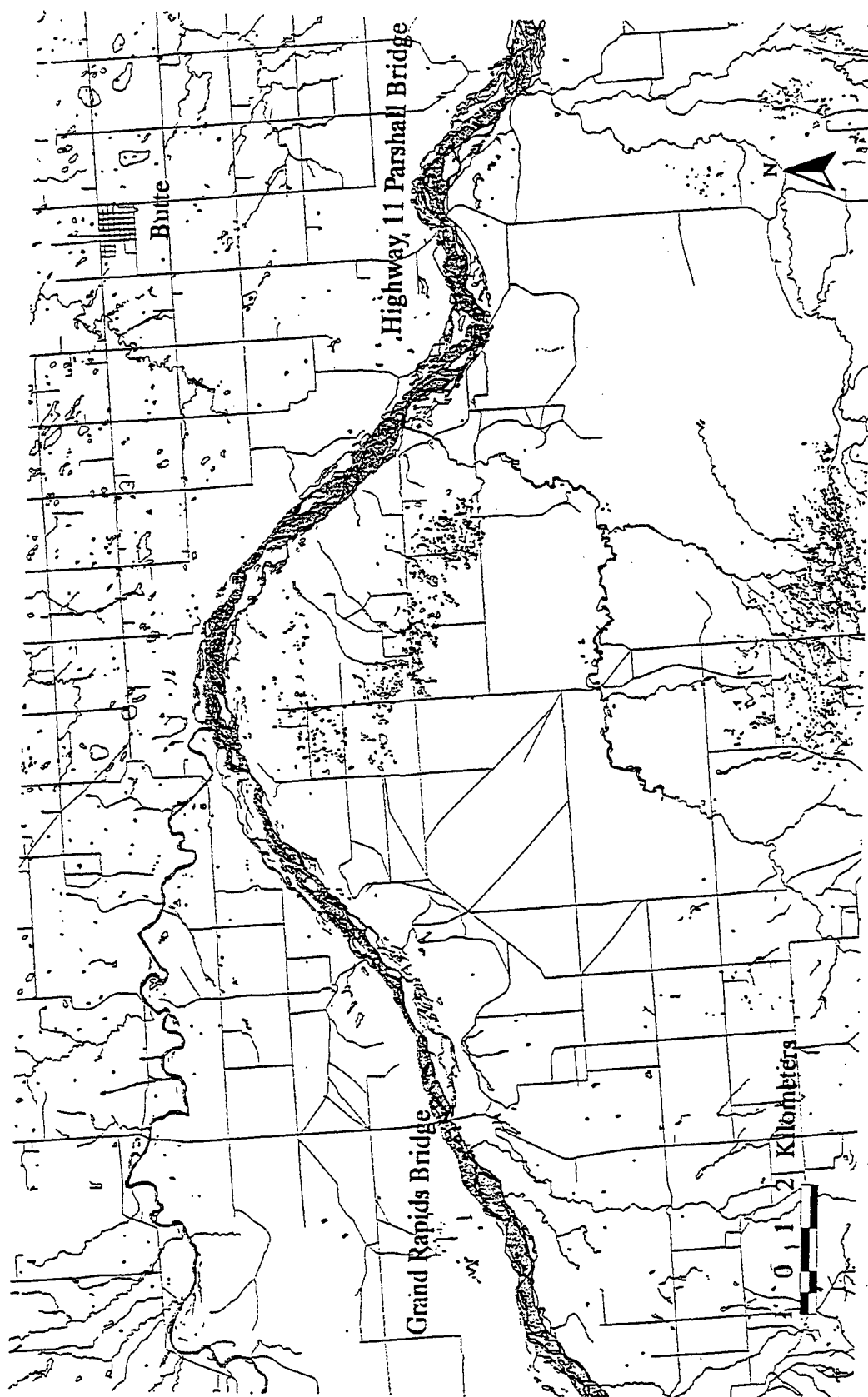
Appendix A cont'd. Study Area Reach 2 on the Niobrara River NE, Pischelville Bridge to Redbird Bridge, 1996 & 1997



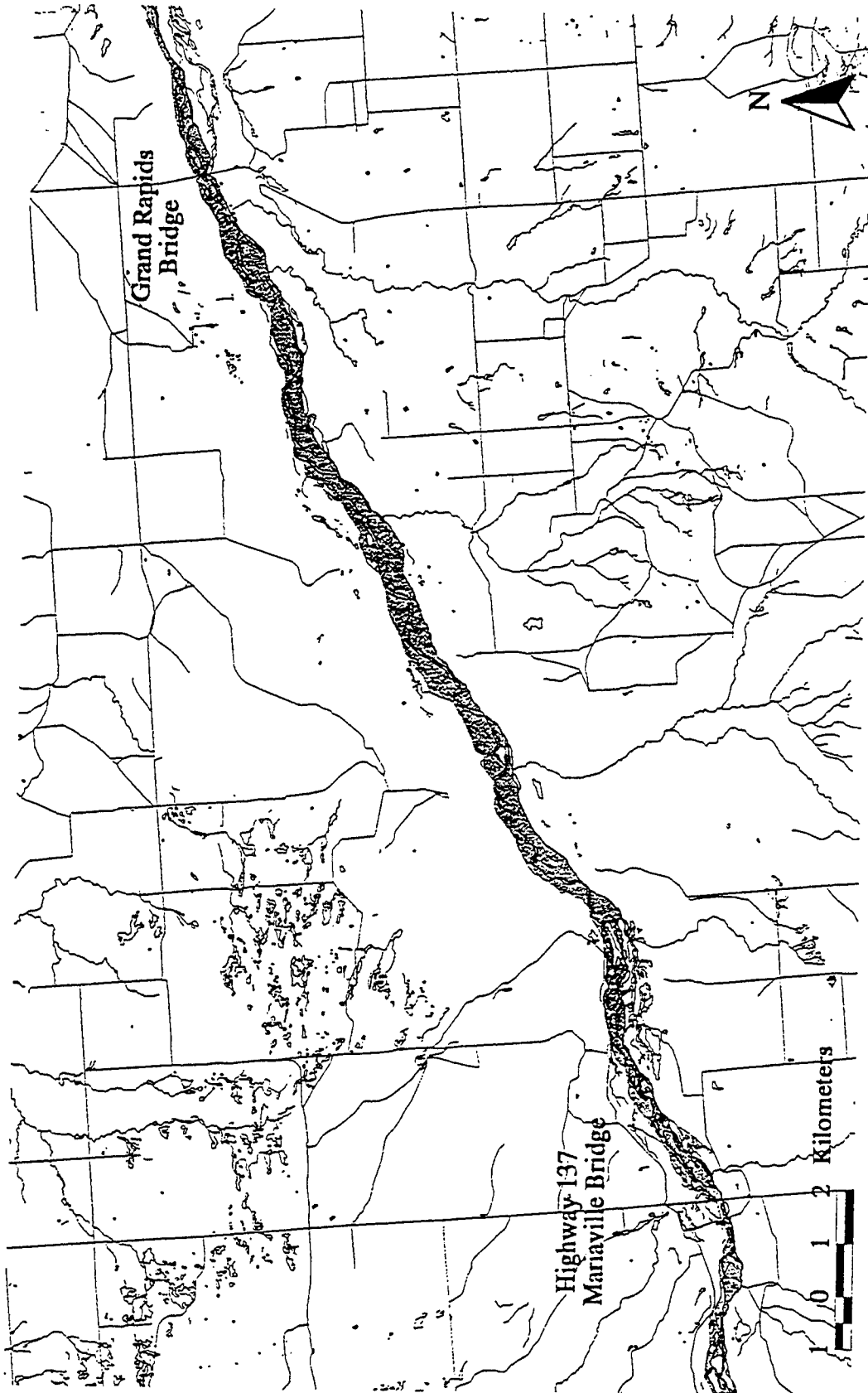
Appendix A cont'd. Study Area Reach 3 on the Niobrara River NE, Redbird Bridge to Highway 281 Bridge, 1996 & 1997



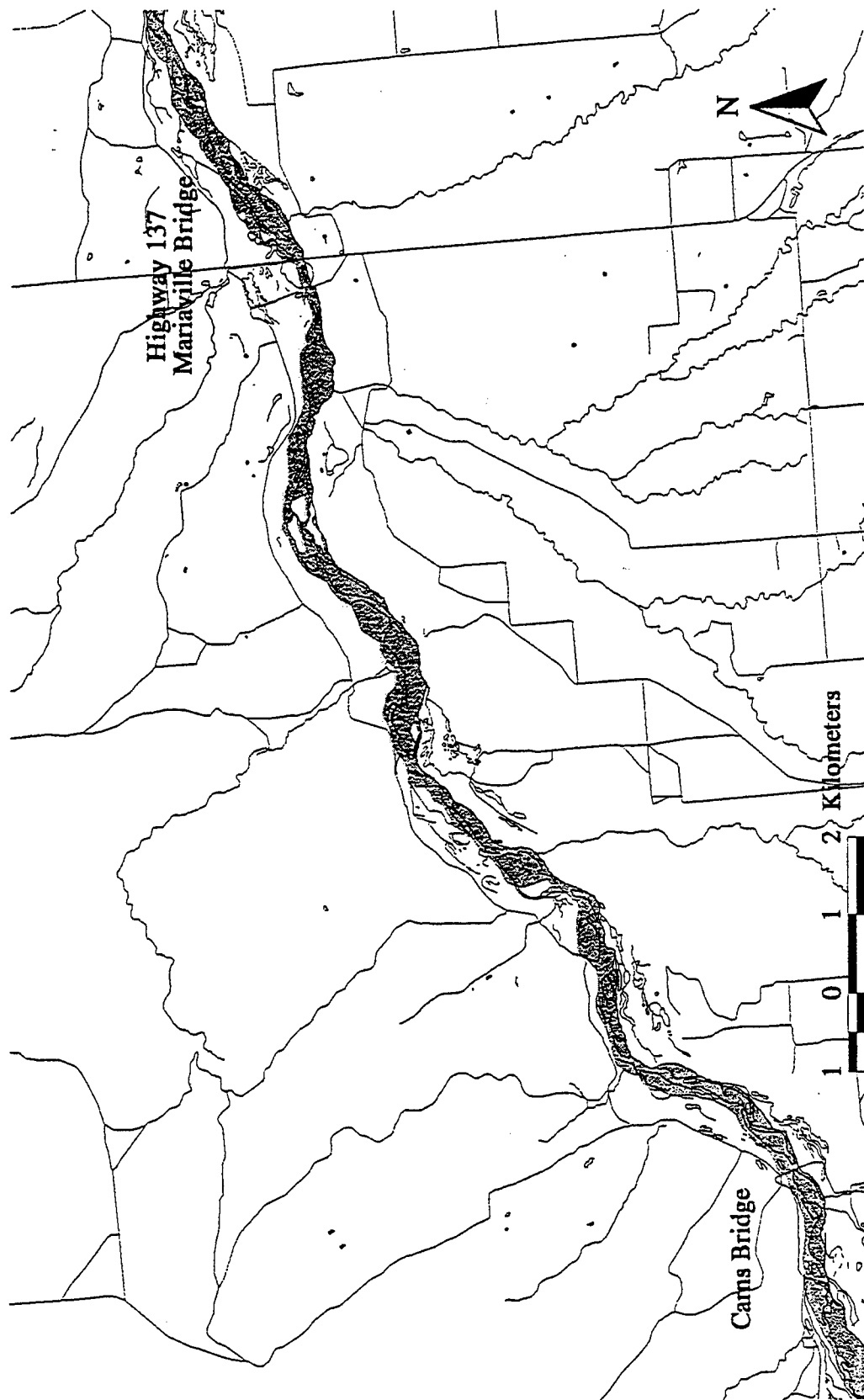
Appendix A cont'd. Study Area Reach 4 on the Niobrara River NE, Spencer Dam to Highway 11 Parshall Bridge, 1996



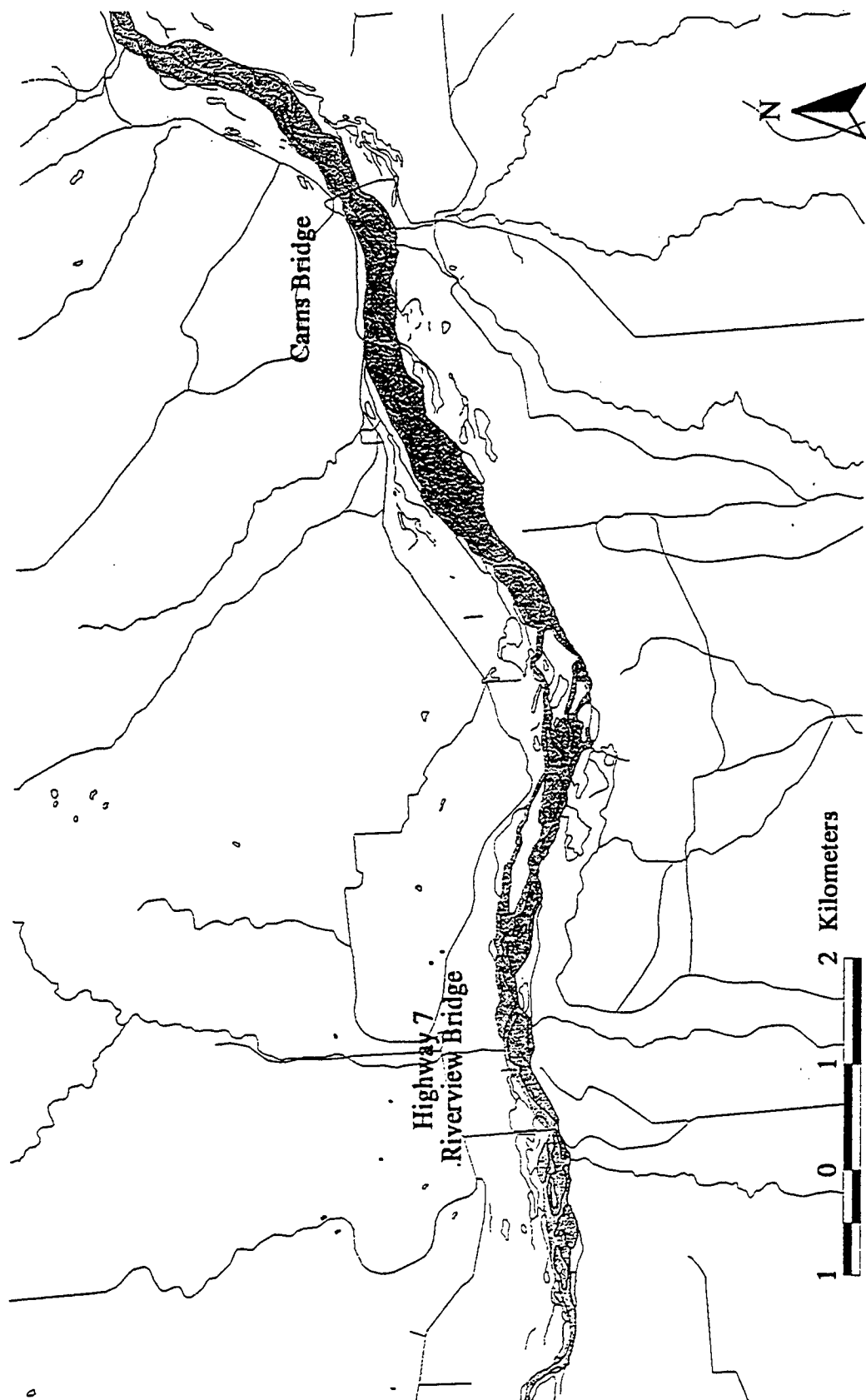
Appendix A cont'd. Study Area Reach 5 on the Niobrara River NE, Parshall Bridge to Grand Rapids Bridge, 1996 & 1997



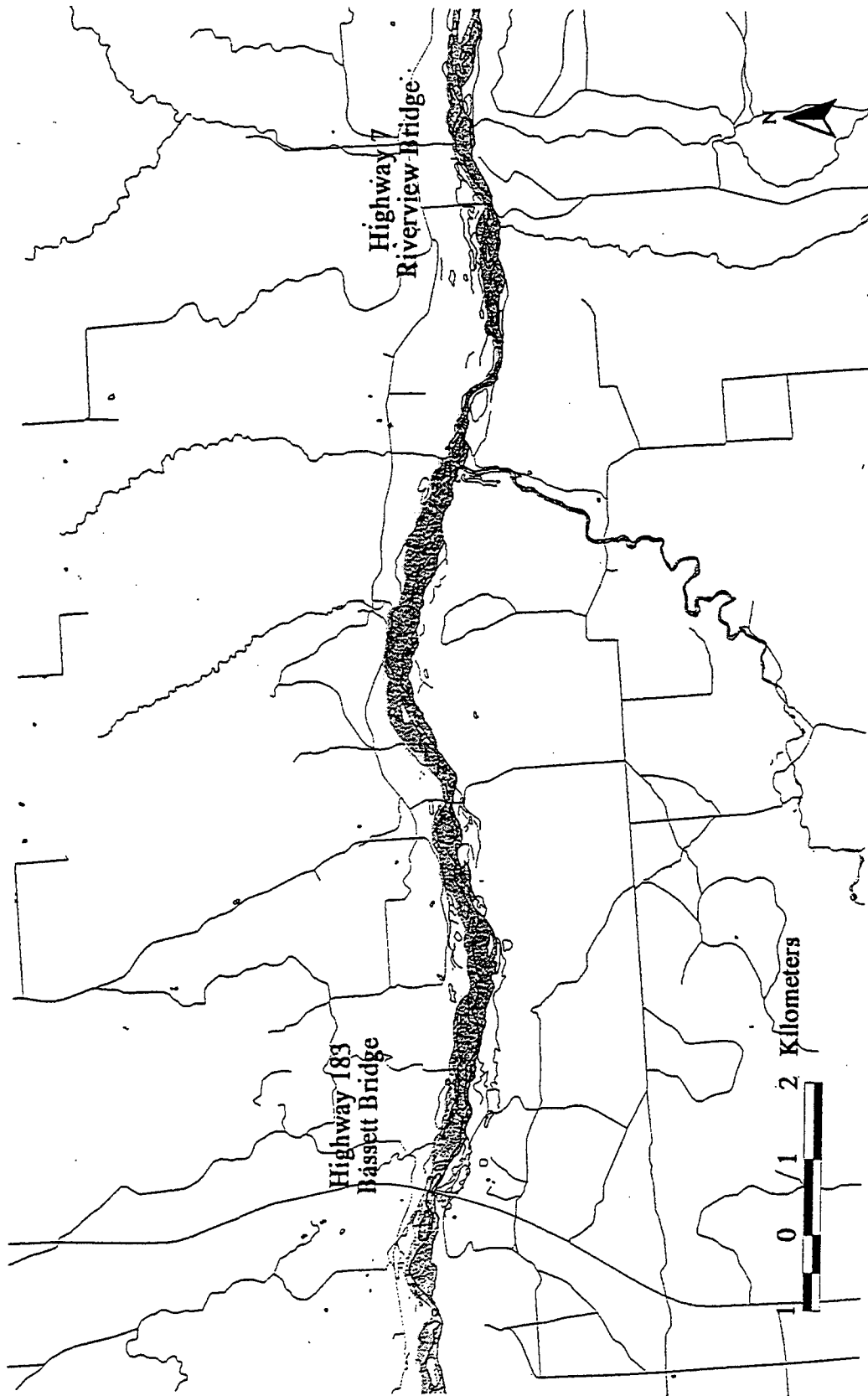
Appendix A cont'd. Study Area Reach 6 on the Niobrara River NE, Grand Rapids Bridge to Highway 137 Bridge, 1996 & 1997



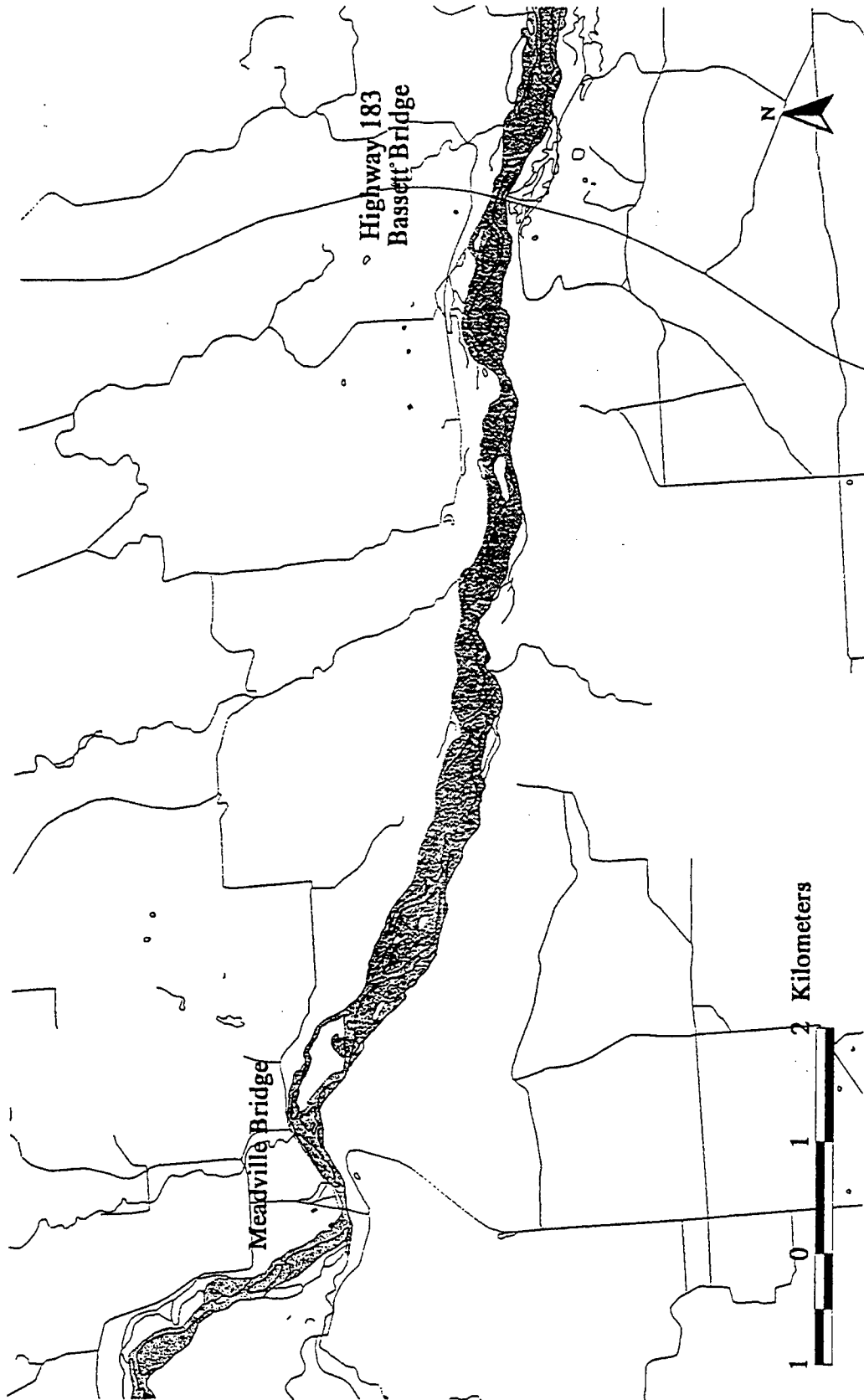
Appendix A cont'd. Study Area Reach 7 on the Niobrara River NE, Highway 137 Bridge to Carns Bridge, 1996



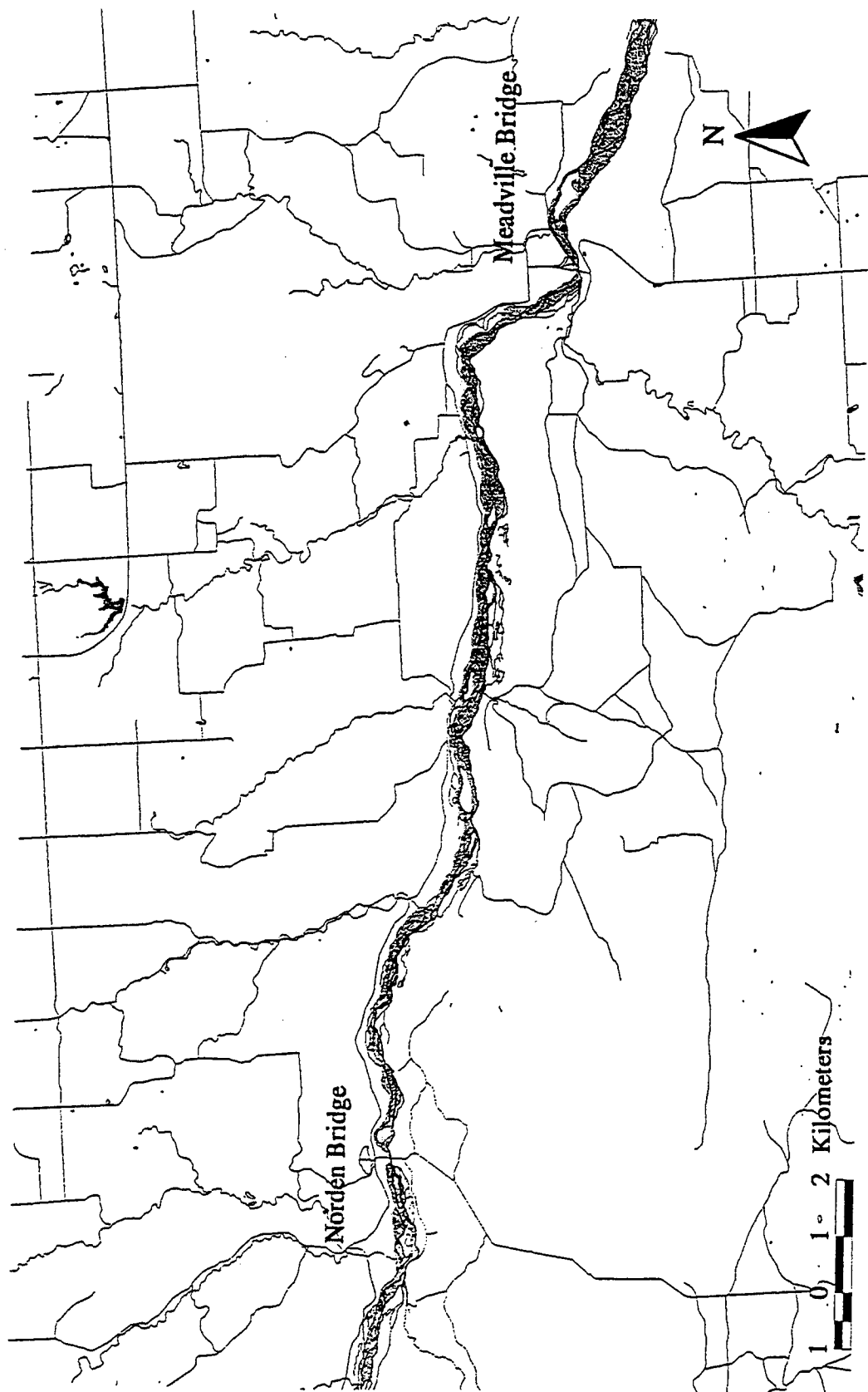
Appendix A cont'd. Study Area Reach 8 on the Niobrara River NE, Carns Bridge to Highway 7 Riverview Bridge, 1996



Appendix A cont'd. Study Area Reach 9 on the Niobrara River NE, Highway 7 Riverview Bridge to Highway 183 Bassett Bridge, 1996 International Piping Plover Census



Appendix A cont'd. Study Area Reach 10 on the Niobrara River NE, Highway 183 Bassett Bridge to Meadville Bridge, 1996 International Piping Plover Census



Appendix A cont'd. Study Area Reach 11 on the Niobrara River NE, Meadville Bridge to Nörden Bridge, 1996 International Piping Plover Census

Appendix B. Standardized data sheets used for recording of data during 1996 and 1997 field seasons.

DESCRIPTORS FOR NEST RECORD CARD - 1996

22 Dry Sand = 1
Wet Sand = 2

23 Substrate Type
1 = Fine Sand
2 = Coarse Sand
3 = Gravel
4 = Silt/Mud
5 = Other

24-26 Blank

27 Dominant Plant Species
1 = Cottonwood sp.
2 = Willow sp.
3 = Sedge sp.
4 = Grass sp.
5 = Other
6 = None

28-30 Percent Vegetative Cover (0 - 100 %)
within 1 meter in diameter centered on the nest bowl

31-32 Approximate Mean Vegetative Cover (cm)

33 -38 Blank

65-66 Blank

77-78 Nest Elevation Above The Water (in. and cm)

79-81 Distance from Nest bowl to Water (m)

NEST RECORD

1 2 3													4 5 6		
SPECIES			SITE SUMMARY (DATA CONTROL 1)										SITE		
7 8 9			10 11 12 13				14 15		16		17 18 19 20				21
NEST			YEAR				HABITAT		REACH		RIVER MILE				
(For Reservoir Use Only)															
22 23		24 25 26 27				28 29 30		31 32		33 34 35 36 37 38					
STATE		TOWNSHIP				RANGE		SECTION		1/4-1/4 SECTION					

NEST DATA (DATA CONTROL 2)

VISIT 39	DATE		OBSERVER 43 44 45	WEATHER		WHOLE EGGS		NEST STATUS 53
	MO 40	DAY 41 42		TEMP 46 47	WIND 48 49	NO. 50	INCHES 51 52	

54 55		56 57 58		NEST SUMMARY 59 60 61		62 63 64		65 66		67	
EGGS HATCH		EGGS ADDL		NEST INITIATION		EXACT TERM DATE		ESTIMATED HATCH DATE		EXPOSURE DAYS	
68 69 70		NEST FATE 71 72		73 74 75		PREDATOR MANAGEMENT 76 77 78		79 80 81			
FATE CAUSE		PRED REASON		CAGE DATE		STROBE DATE		OTHER			

COMMENTS:

NEST SITE MAP

US Army Corps
of EngineersUnprocessed and Endangered
Species and other birds are protected

NEST RECORD PROCEDURES

SPECIES

Box 1-3
A.O.U. Species No.
277 Piping Plover
074 Least Tern

SITE

Box 4
River Reach (See Box 16)
Box 5-6
Site Number

SITE SUMMARY (Data Control 1)

Box 7-9
Total Nests w/in Reach
Box 10-13
Year Nest Located
Box 14-15
Nest Site Habitat
River Systems
01 Sandbar
02 Beach or Shore
03 Island
04 Island Beach
Reservoir Systems
05 Beach
06 Peninsula/Point
07 Island
08 Island Beach
09 Isl. Peninsula/Point
10 Other
Box 16
Reach Nest Located In
1 Fort Peck Reservoir
2 Fort Peck River
3 Lake Sakakawea
4 Garrison River
5 Lake Oahe, ND
6 Lake Oahe, SD
7 Fort Randall River
8 Lewis and Clark
9 Gavins Point River
Box 17-21
River Mile of Colony Site
to Nearest 10th of Mile
Box 22-38
Legal Description of
Colony Site (Reservoirs)

NEST DATA (Data Control 2)

Box 39
Number of Nest Visit
1 Final Nest Visit
Box 40-42
Date of Nest Visit
Box 43-45
Observers Initials
Box 46-47
Temp to Nearest 3°F
Box 48-49
Wind to Nearest 5mph
Box 50
No. Eggs in Nest

Box 51-52
Incubation Stage
(See Diagram Below)
00 Laying Stage
nn Number Days Inc.
41 Pipped
53 Hatched

Box 53
Status of Nest
0 Unknown
1 Undist/Normal
2 Abandoned
3 Eggs Missing from
Previous Visit
4 Hatched
5 Destroyed
6 Other

NEST SUMMARY

Box 54
Number of Eggs Hatched
Box 55
Nonviable Eggs in Nest
Box 56-58
Nest Initiation Date
Plovers
(2/50)-1)-51&52-41&42
Terns
(1/50)-51&52-41&42
Box 59-61
Exact Tern Date
(Only if Known)
000 Unknown
Box 62-64
Computer Generated
Box 65-66
Computer Generated
Box 67
From Productivity Rec.

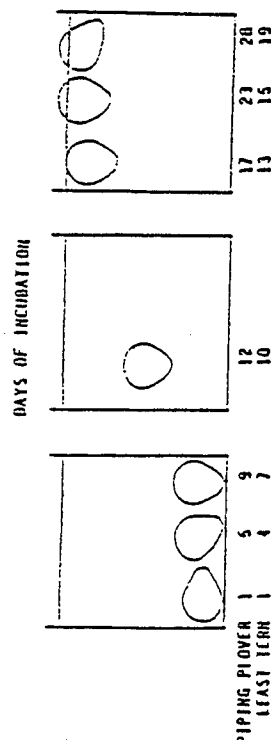
NEST FATE

Box 68 Fate
1 Hatched
2 Destroyed
3 Abandoned
4 Nonviable Eggs
5 Unknown
Box 69-70 Cause
Hatched
10 Other (explain)
11 Chicks in Bowl
12 Chicks on Site
13 Hatched Egg Shells
14 Pipping Fragments
15 Chick Droppings
Destroyed Flooded
20 Other (explain)
21 Eggs Washed Out
22 Nest Filled
23 No Eggs
24 Flood Debris
Destroyed Weather
30 Other (explain)
31 Incubation Suspended
32 Incubation Smashed
33 Incubation Blown Out
Destroyed Predator
40 Other (explain)

41 Tracks w/in 2m
of Nest
42 Dec Egg Shells
43 Egg Yolk in Bowl
44 Predator Observed
Destroyed
50 Sandbar Erosion
60 Human Disturbance
70 Other (explain)
Abandoned
80 Other (explain)
81 Observer Disurb.
Box 71 Known Predator
1 Mink
2 Raccoon
3 Coyote
4 Red Fox
5 Domestic Dog
6 Striped Skunk
7 Ring-billed Gull
8 American Crow
9 Other
Box 72 Factor For
Predator Identification
1 Predator Observed
2 Tracks Near Nest
3 Destroyed Egg
Characteristics

PREDATOR MANAGEMENT

Box 73-81
Date of Management
Applications



DESCRIPTORS FOR NEST RECORD CARD - 1997

17 Dry Sand = 1
Wet Sand = 2

18 Substrate Type
1 = Fine Sand
2 = Coarse Sand
3 = Gravel
4 = Silt/Mud
5 = Other

19-21 Blank

22 Dominant Plant Species
1 = Cottonwood sp.
2 = Willow sp.
3 = Sedge sp.
4 = Grass sp.
5 = Other
6 = None

23-24 Approximate Mean Height of Vegetative Cover (cm)

25-27 Percent Vegetative Cover (0 - 100 %)
1 meter in diameter centered on the nest bowl

28-33 Blank

61-63 Nest Elevation Above the Water (in. and cm)

61-63 Distance from Nest to Nearest Water (m)

NEST RECORD

SITE SUMMARY															
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
SPECIES			YEAR-RCH-NEST NO.						HABITAT		RIVER MILE				

LOCAL SITE NAME: _____

(For Reservoir Use Only)																
17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33
1/4-1/4 SECTION						SECTION		TOWNSHIP			RANGE				STATE	

NEST DATA														
VISIT	DATE			OBSERVER	WEATHER				WHOLE EGGS		NEST STATUS			
	MO	DAY			TEMP	WIND		NO.	INCUB.					
34	35	36	37	38	39	40	41	42	43	44	45	46	47	48

NEST SUMMARY										
49	50	51	52	53	54	55	56	57	58	59
NEST INITIATION			NEST FATE	CAUSE		PRED	REASON	EGGS HATCH	EGGS ADDED	CHICKS FLEDGED

MANAGEMENT ACTIVITIES				COMMENTS: _____	NEST SITE MAP
60	61	62	63		
ACT	DATE				

NEST RECORD PROCEDURES

SITE SUMMARY

Species: Boxes 1-3

A.O.U. Species #

277 - Piping Plover

074 - Least Tern

Nest ID:

Boxes 4-5: Year (Last 2 numbers)

Box 6: Reach ID

Reach nest is located in

1 - Fort Peck Lake

2 - Fort Peck River

3 - Lake Sakakawea

4 - Garrison River

6 - Lake Oahe

7 - Fort Randall River

8 - Lewis & Clark Lake

9 - Gavins Point River

Boxes 7-9: Nest Number

Habitat: Boxes 10-11

Nest Site Habitat

River Systems

01 - Sandbar

02 - Riverbank

03 - Island

04 - Island Beach

05 - Other

Reservoir Systems

06 - Peninsula/Point Beach

07 - Island

08 - Island Beach

09 - Linear Shoreline Beach

10 - Other

River Mile: Boxes 12-16

River Mile of nest site to the
nearest 10th of a mile

Site Name: Name of Site or

nearest major feature (Reservoir)

Legal Description: Boxes 17-31

Legal Description of Nest Site
(Reservoir)

State: Boxes 32-33

2 letter State ID

NEST DATA

Visits: Box 34

Number of Nest Visit

T = Final Nest Visit

Date: Boxes 35-37

Date of Nest Visit

Observer: Boxes 38-40

Observer's Initials

Weather

Temp: Boxes 41-42

Temp to the nearest 3°F

Wind: Boxes 43-44

Wind to nearest 5 MPH

Whole Eggs No: Box 45

No. of eggs in nest

Incub.: Boxes 46-47

Incubation Stage

(See Diagram Below)

00 - Laying Stage

nn - Number Days Inc.

44 - Egg(s) Pipped

55 - Egg(s) Hatched

Nest Status: Box 48

Status of Nest

0 - Unknown

1 - Undisturbed/Normal

2 - Abandoned

3 - Eggs missing from
previous visit

4 - Hatched

5 - Destroyed

6 - Other (Explain under
Comments)

NEST SUMMARY

Nest Initiation: Boxes 49-51

Nest Initiation Date

Plovers (Complete Clutch):

Visit Date - $\{[(2 \times \# \text{ of eggs}) - 1] +$
Incubation Stage}

Terns (Complete Clutch):

Visit Date - $\{(\# \text{ of eggs} +$
Incubation Stage)

Nest Fate: Box 52

1 - Nest Hatched

2 - Nest Destroyed

3 - Nest Abandoned

4 - Nonviable Eggs

5 - Nest Fate Unknown

6 - Nest Collected

Cause: Boxes 53-54

Hatched

10 - Other (explain)

11 - Chicks in Bowl

12 - Chicks on Site

13 - Hatched Egg Shells

14 - Pipping Fragments

15 - Chick Droppings

16 - Incubator

Destroyed - Flooded

20 - Other (explain)

21 - Eggs Washed Out

22 - Nest filled, No eggs

23 - Flood Debris

Destroyed - Weather

30 - Other (explain)

31 - Eggs Suspended in Sand

32 - Eggs Smashed in Bowl

33 - Eggs Blown out of Bowl

Destroyed - Predator

40 - Other (explain)

41 - Tracks within 6F of Nest

42 - Destroyed Eggs

43 - Egg Yolk in Bowl

44 - Predator Observed

Destroyed - Other

50 - Sandbar Erosion

60 - Human Disturbance

70 - Unknown Causes

80 - Abandoned

90 - Livestock

Known Predator - Box 55

1 - Mink

2 - Raccoon

3 - Avian

4 - Reptile

5 - Other (Comments)

Reason for Pred ID - Box 56

1 - Predator observed

2 - Tracks near nest

3 - Dist. Egg Characteristics

Eggs Hatched - Box 57

Number of Eggs Hatched

Eggs Added - Box 58

Nonviable Eggs in Nest

Chicks Fledged - Box 59

From Productivity Record

MANAGEMENT

ACTIVITIES

Activity - Box 60

C - Plover Nest Caged

S - Scrape Light Installed

M - Nest Moved

O - Other (Explain under
Comments)

Activity Date - Boxes 61-63

DAYS OF INCUBATION		28	19
		12	10
		9	1
		PIPING PLOVER	LEAST TERN

ADULT CENSUS SITE RECORD WITH PRODUCTIVITY ESTIMATES

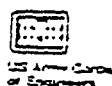
1 2 3 <div style="border: 1px solid black; width: 40px; height: 20px; margin: 0 auto;"></div>	<div style="border: 1px solid black; width: 80px; height: 20px; margin: 0 auto;"></div>	4 5 6 7 8 9 <div style="border: 1px solid black; width: 100px; height: 20px; margin: 0 auto;"></div>
SITE	SITE SUMMARY	MONTH DAY YEAR
10 <div style="border: 1px solid black; width: 20px; height: 20px; margin: 0 auto;"></div>	11 <div style="border: 1px solid black; width: 20px; height: 20px; margin: 0 auto;"></div>	12 13 <div style="border: 1px solid black; width: 40px; height: 20px; margin: 0 auto;"></div>
14 <div style="border: 1px solid black; width: 20px; height: 20px; margin: 0 auto;"></div>	15 16 <div style="border: 1px solid black; width: 40px; height: 20px; margin: 0 auto;"></div>	17 18 <div style="border: 1px solid black; width: 40px; height: 20px; margin: 0 auto;"></div>
19 20 21 <div style="border: 1px solid black; width: 60px; height: 20px; margin: 0 auto;"></div>	22 23 24 <div style="border: 1px solid black; width: 60px; height: 20px; margin: 0 auto;"></div>	
SURVEY TYPE	SURVEY TIME	HABITAT
REACH	TEMP	WIND WEATHER
OBSERVERS INITIALS		
(For River Use) (For Reservoir Use Only)		
25 26 27 28 29 <div style="border: 1px solid black; width: 80px; height: 20px; margin: 0 auto;"></div>	30 31 <div style="border: 1px solid black; width: 40px; height: 20px; margin: 0 auto;"></div>	32 33 34 35 <div style="border: 1px solid black; width: 60px; height: 20px; margin: 0 auto;"></div>
36 37 38 <div style="border: 1px solid black; width: 60px; height: 20px; margin: 0 auto;"></div>	39 40 <div style="border: 1px solid black; width: 40px; height: 20px; margin: 0 auto;"></div>	41 42 43 44 45 46 <div style="border: 1px solid black; width: 100px; height: 20px; margin: 0 auto;"></div>
RIVER MILE	STATE	TOWNSHIP
RANGE	SECTION	1/4-1/4 SECTION

PIPING FLOWERS <div style="display: flex; justify-content: space-around; margin-top: 10px;"> <div style="text-align: center;">47 48 <div style="border: 1px solid black; width: 40px; height: 20px; margin: 0 auto;"></div> TOTAL ADULTS</div> <div style="text-align: center;">49 50 <div style="border: 1px solid black; width: 40px; height: 20px; margin: 0 auto;"></div> NESTS</div> <div style="text-align: center;">51 52 <div style="border: 1px solid black; width: 40px; height: 20px; margin: 0 auto;"></div> BROODS</div> </div>	LEAST TERNS <div style="display: flex; justify-content: space-around; margin-top: 10px;"> <div style="text-align: center;">53 54 <div style="border: 1px solid black; width: 40px; height: 20px; margin: 0 auto;"></div> TOTAL</div> <div style="text-align: center;">55 56 <div style="border: 1px solid black; width: 40px; height: 20px; margin: 0 auto;"></div> NESTS</div> <div style="text-align: center;">57 58 <div style="border: 1px solid black; width: 40px; height: 20px; margin: 0 auto;"></div> BROODS</div> </div>
--	--

PRODUCTIVITY RECORD

DATE			AGE OF CHICKS OBSERVED																
MO	DAY		SPECIES		0-5		5-7		7-10		10-15		15-20		20-24		FLEDGE		
59	60	61	62	63	64	65	66	67	68	69	70	71	72	73	74	75	76	77	78

Additional Record Space on Back #



This document is a reproduction of the original document.

79 80 <div style="border: 1px solid black; width: 40px; height: 20px; margin: 0 auto;"></div> FLOWERS FLEDGE	81 82 <div style="border: 1px solid black; width: 40px; height: 20px; margin: 0 auto;"></div> TERNS FLEDGE
---	---

CENSUS RECORD PROCEDURES

SITE SUMMARY

Box 1
River Reach (See Box 14)

Box 2-3

Site Number

Box 4-9

Date of Census

Box 10

Survey Type

- 1 Walking
- 2 Automobile
- 3 Boat
- 4 Airplane/Helicopter
- 5 Other (explain)

Box 11

Survey Technique

- 1 Total Adult Count
- 2 Visual Estimate
- 3 Best Guess Estimate
- 4 2X Nests + Broods
(Must fill in boxes
30-55 & 56-59)

Box 12-13

Habitat Type

- 01 Sandbar
- 02 Beach
- 03 Island
- 04 Peninsula
- 05 Feeding/Flying
- 10 Other (explain)

Box 14

Reach Site Located In

- 1 Fort Peck Reservoir
- 2 Fort Peck River
- 3 Lake Sakakawea
- 4 Garrison River
- 5 ~~_____~~
- 6 Lake Oahe, SD
- 7 Fort Randall River
- 8 Lewis & Clark Res.
- 9 Gavins Point River

Box 15-16

Temp to Nearest 5° F

Box 17-18

Wind to Nearest 5 mph

Box 19-24

All Observers Initials

Box 25-29

River Mile of Colony Site
to Nearest 10th of Mile

Box 30-46

Legal Description of
Colony Site (Reservoirs)

CENSUS

Box 47-48

Total Adult Plovers

Observed on Site

Box 49-50

Number of Active Plover

Nests on Site

Box 51-52

Number of Plover Broods
on Site

Box 53-54

Total Adult Terns
Observed on Site

Box 55-56

Number of Active Tern
Nests on Site

Box 57-58

Number of Tern Broods
on SitePRODUCTIVITY
RECORD

Box 59-61

Date of Site Visit

Box 62-64

277 Piping Plover
074 Least Tern

Box 65-73

Age of Chicks Observed
(Use separate row for each
species)

Box 74-82

Total Plovers and Terns
Fledged at the Site

Box 83-88

Computer Generated

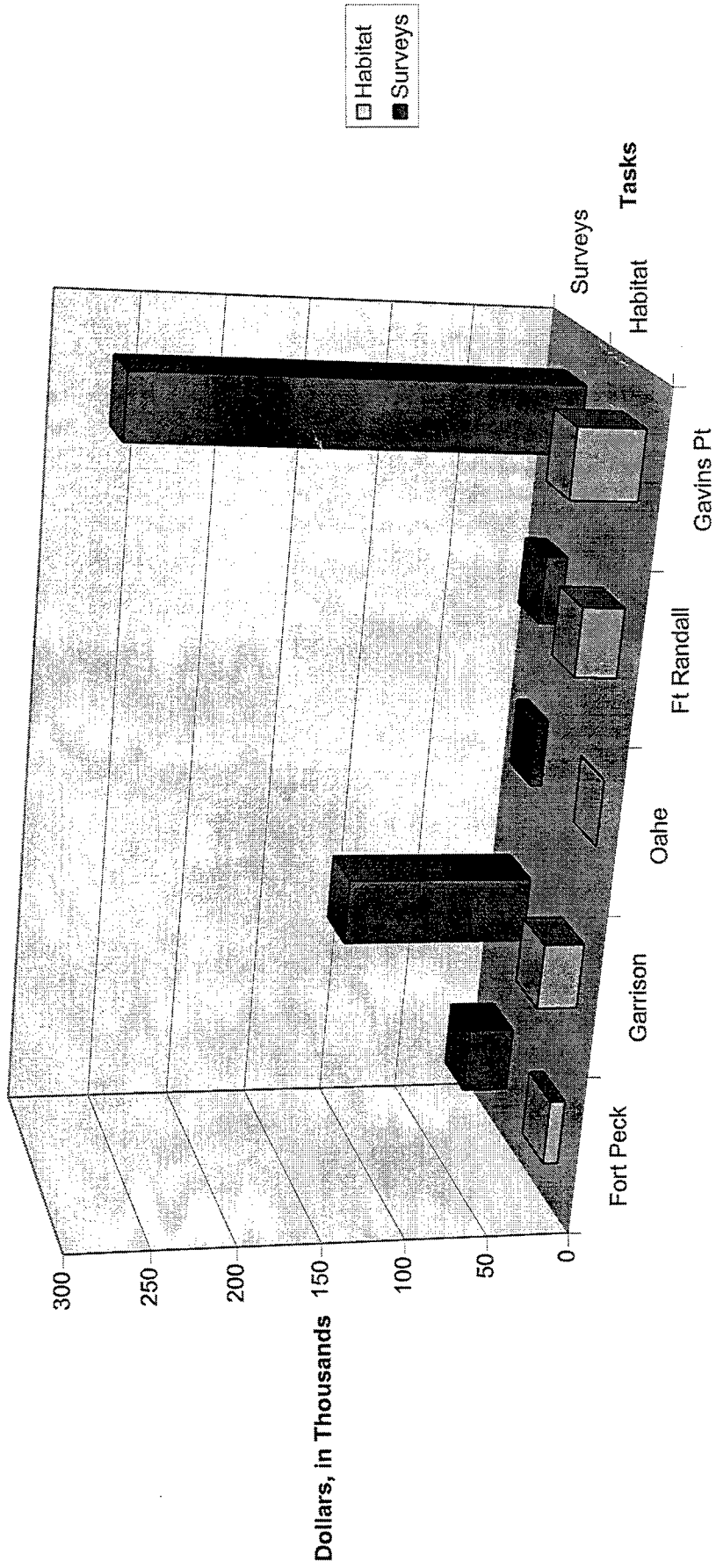
COMMENTS:

PIPING PLOVER		Dowry		Feathered		Fledged		Fledged		
LEAST TERN		Dowry		Feathered		Fledged		Fledged		
DATE		SPECIES		0-5	5-7	7-10	10-15	15-20	20-24	FLEDGE
MO	DAY									
Total on Front										

83	84	85	SITE FLEDGE RATIO PIPING PLOVER	86	87	88	SITE FLEDGE RATIO LEAST TERN

APPENDIX H
BUDGET INFORMATION

Corps' FY 98 Tern and Plover Expenditures



Project Offices